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Sacramento Area Consultants, CA

Prepared for

Sacramento Regional County Sanitation
District, CA

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Sacramento Regional
Wastewater Management Program

SEWAGE SLUDGE MANAGEMENT PROGRAM

VOLUME 1

SSMP FINAL REPORT, WORK PLANS, AND SOURCE SURVEY

September 1979

Sacramento Regional County Sanitation District

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

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16. Abstract (Limit: 200 words)

Volume 1 of the Sewage Sludge Management Program (SSMP) was prepared for the Sacramento Regional County Sanitation District by Sacramento Area Consultants. The SSMP involved approximately three years of detailed investigative studies and monitoring directed primarily at the engineering, economical, and environmental aspects of storing liquid anaerobically digested sludge in solids storage basins and the disposal of this sludge via dedicated land disposal. Included in this volume is the "SSMP Final Report" which serves as a summary report condensing the most important information generated during the three years of the program. The various work plans and proposals for the program were also included in this volume to allow the reader to trace the evolution of the SSMP work tasks and associated costs. Lastly, Volume 1 contains the SSMP source survey, the purpose of which was to determine which existing treatment plants within the District's service area are receiving excessive levels of heavy metals and chlorinated hydrocarbons.

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Odor control
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VOLUME 1

SSMP FINAL REPORT, WORK PLANS AND SOURCE SURVEY

The Sewage Sludge Management Program (SSMP) has involved approximately three years of detailed investigative studies and monitoring directed primarily at the engineering, economical and environmental aspects of storing liquid anaerobically digested sludge in solids storage basins (SSBs) and the disposal of this sludge via dedicated land disposal (DLD). Precise operational and design criteria have been developed for the SSB-DLD system to assure efficient operation and environmental acceptability. Over 40 reports have been prepared documenting the results of these studies.

Reproducing major SSMP final reports allows a complete summary of the program to be readily available in a consolidated set of volumes. Volume 1 of the eleven volumes includes the following reports.

- Sewage Sludge Management Program Final Report
- February 17, 1976 Revised Work Plan and Proposal
- December 10, 1976 Revised Work Plan and Proposal
- Supplemental Study: Sewage Sludge Processing and Disposal
- May 30, 1978 Recommended Program Revisions
- Revisions to May 30, 1978 Recommended Program Revisions

- November 6, 1978 Proposed Scope Changes

- Source Survey Phase I and II

These reports summarize work conducted in subtasks 1.2, 1.3, and task 3 of the SSMP. The SSMP Final Report serves as a summary report condensing the most important information generated during the three years of the program. Reports are also included in this volume which allow the reader to trace the evolution of work tasks and program costs since the beginning of the SSMP.

SEWAGE SLUDGE MANAGEMENT PROGRAM
FINAL REPORT

September 18, 1979

Sacramento Area Consultants
Sacramento, California

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September 18, 1979

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SEWAGE SLUDGE MANAGEMENT PROGRAM
FINAL REPORT

Enclosed is the Sewage Sludge Management Program (SSMP) final report. This report was prepared in accordance with subtask 1.3 of the February 17, 1976 Revised Work Plan and Proposal of the SSMP as revised December 10, 1976 and May 30, 1978 by Sacramento Area Consultants. The review draft of this report was submitted on February 27, 1979.

The SSMP has involved approximately 3 years of monitoring and detailed investigative studies directed primarily at the engineering, economical and environmental aspects of storing liquid digested sludge in solids storage basins (SSBs) and the disposal of this sludge via dedicated land disposal (DLD). Precise operational and design criteria have been developed for the SSB-DLD system to assure efficient operation and environmental acceptability. Over 40 reports have been prepared documenting the results of these studies (see Appendix A).

Odor risk, associated principally with the SSBs, has been the major environmental obstacle to be overcome. An unparalled effort was undertaken in the SSMP to meet the District's specific odor criteria adopted as design objectives for the Regional Plant. This effort included the evaluation of the effectiveness of special mitigation measures designed for reducing odor risks to meet the specified design objectives. On January 22, 1979, the Regional District Board of Directors certified the SSMP Environmental Impact Report (EIR) and approved the SSB-DLD project, as recommended in the EIR. This is evidence that the project is viewed as cost-effective and one which can be implemented in an environmentally sound manner.

SACRAMENTO AREA CONSULTANTS 1501 NORTH BROADWAY WALNUT CREEK CALIFORNIA 94596 (415) 937-9010

The successful conclusion of the SSMP would have been impossible without the aid of our major subcontractors, Eutek, Inc., Baier Agronomy, Inc., Lowry and Associates and Spray Waste, Inc., and the help of the Central Plant operators and the guidance provided by District staff.

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SEWAGE SLUDGE MANAGEMENT PROGRAM
1979 PROGRESS SEMINAR

Tuesday, February 27, 1979 - 9:00 a.m.
City of Sacramento - American River Water Treatment Plant

		AGENDA	Exhibit
9:00	9:15	Program Update - SAC	1
9:15	9:45	SSB Operation and Performance - SAC Surface, Solids and Site Monitoring Review of 1977 Mixer Study Review of 1978 Mixer Study	2
9:45	10:00	Questions and Discussion	
10:00	10:15	Coffee Break	
10:15	11:45	Odor Studies - Eutek Development of Design Criteria for Wind Machines and Barriers Micrometeorological Data Gathering Preliminary Reassessment of Odor Risk Odor Interaction of ESB and SSB Systems Effectiveness of Wind Machines and Barriers for Control of Large Area Odor Emission Assessment and Control of Large Emission Area Odor Risk	3
11:45	12:00	Questions and Discussion	
12:00	1:00	Lunch Break	
1:00	2:15	Dedicated Land Disposal Sludge Spreading Studies - SAC, Baier Agronomy Inc., and Lowry and Associates Dredge and Booster Pump Operation and Performance Subsurface Injection Surface Spreading and Tillage Fixed Distribution Site Monitoring Conclusions	4
2:15	2:30	Questions and Discussion	
2:30	3:00	Environmental Impact Report - SAC Major Alternatives Movie of Recommended and Alternative Projects Project Comparison Recommended Project and Mitigation Measures	
3:00	3:15	Questions and Discussion	
3:15	3:30	Coffee Break	
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CHAPTER 1

INTRODUCTION

The certification of the Sewage Sludge Management Program Final Environmental Impact Report and adoption of the recommended project on January 22, 1979 by the Sacramento Regional County Sanitation District (District) Board of Directors culminates over three years of detailed investigative work directed primarily at the engineering, economic and environmental aspects of storing liquid digested sludge in solids storage basins (SSBs) and the eventual disposal of this sludge via dedicated land disposal (DLD). Acceptance of the SSB-DLD alternative by the District's Board of Directors, as recommended in the Environmental Impact Report (EIR), is evidence that this alternative is viewed as being cost-effective and one which can be implemented in an environmentally sound manner. A background of the Sacramento Regional Wastewater Management Program and its Sewage Sludge Management Program (SSMP), along with a brief description of the work which has been conducted in the SSMP over the last three years, is presented below.

SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM

In the early 1970's, broad independent studies were initiated by the City and County of Sacramento to plan for increasing wastewater loadings and higher effluent quality requirements. The city's study was conducted for the area within its boundaries while the county filed reports on the surrounding Natomas and the Northeast-Central area. It was realized as a result of these studies that a regional solution would be desirable in order to solve wastewater problems within these areas. Accordingly, a combined project report for the Sacramento Regional Wastewater Management Program was issued in March 1973. In June of that year, the State Water Resources Control Board (SWRCB) granted concept approval for the project, and in September the City and County of Sacramento contracted with Sacramento Area Consultants (SAC) for engineering services and implementation of the project. Subsequently, on October 29,1973, the new Sacramento Regional County Sanitation District (District) was created and in 1974 the voters of the District approved a $75 million bond issue to finance the local government's share of the project.

An EIR, evaluating the overall impacts of the Regional Wastewater Management Program, was filed with the March 1973 project report. Regional impacts received a second review when EPA completed an environmental impact statement in April 1975. Since the initial engineering and environmental studies, several investigations have been completed for specific project components.

SEWAGE SLUDGE MANAGEMENT PROGRAM

SWRCB concept approval for the Regional Plant required the District to further refine and identify the specific alternatives for wastewater solids processing and disposal set forth in the March 1973 project report. An in depth report titled "Study of Wastewater Solids Processing and Disposal" was completed by SAC in June 1975[1] and accepted by the SWRCB, fulfilling this requirement.

The June 1975 study was comprehensive in scope, reviewing wastewater solids characteristics, processing and disposal alternatives. Four systems were selected for extensive engineering, economic, and environmental considerations. Detailed studies of these alternatives resulted in the selection of a recommended system to be implemented with a management program. The program consisted of source controls, further studies of SSBs and an agricultural utilization demonstration project. The recommended system consited of incineration for dewatered screenings, grit and thickened scum, digestion of primary and thickened waste activated sludge, and storage of digested sludge in SSBs with seasonal utilization on agricultural land.

The solids study also recommended a 4-year solids management demonstration program, principally for the SSBs and agricultural reclamation, to investigate the environmental consequences and to provide precise design and operational criteria which would enable the District to proceed with confidence in implementing a long-term solids management program. Following the acceptance of the solids study by the SWRCB, SAC submitted, in October of 1975, the original work plan and proposal for the District's SSMP.[2]

Subsequent to the submittal of the work plan and proposal discussions with the District indicated the need to eliminate the agricultural utilization aspect of the sludge program. The Districts' concerns with the reclamation phase of the program dealt primarily with the large expenditure of funds for the agricultural use demonstrations ($1.641 million of the $2.227 million original program costs) when (1) the District had no assurance that regulatory controls would not prevent such use; (2) the District could not determine how much of the work within the scope of the demonstrations would be considered a duplication of efforts already being funded by the SWRCB in Southern California and the San Francisco Bay Area; (3) the District could not guarantee that sewage sludge reclamation on nearby farms would be accepted by the agricultural community; and (4) the limitations on reclamation indicated by the demonstrations might require the District to acquire and manage large land areas, and this might prove to be politically unacceptable.

As a result of these concerns the District sponsored a staff workshop on December 19, 1975 to determine what other sludge processing and disposal alternatives might be applicable to the Regional Wastewater Management Program. The District selected four alternatives for new cost, energy and land use comparisons; these included an up-dated agricultural reclamation alternative and three new on-site DLD alternatives as described below.

Alternative	Description
A	Digestion-SSB storage-agricultural reclamation
B	Digestion-dewatering-County Sanitary landfill
C	Digestion-SSB storage-permanent lagoons
D	Digestion-SSB storage-on-site liquid landfill (dedicated land disposal)

SAC studied these alternatives extensively in a January 25, 1977, Supplemental Study: Sewage Sludge Processing and Disposal: Sacramento Regional Wastewater Treatment Plant Sewage Sludge Management Program.[5] The study did not put forth a recommended alternative, although C and D were ranked equally and superior to the other two alternatives based on economics, energy use, and land use. Permanent lagoons (C) were not considered a viable alternative due to aesthetics and the necessary commitment of large area of land to permanent sludge lagoons.

Alternative D was not fully recommended as questions still remained regarding environmental impacts of SSBs. A paramount consideration was potential odor generation with resulting nuisance conditions and impacts on the groundwater. Furthermore, it remained to be proven that the on-site liquid landfill (DLD) could be implemented without unacceptable adverse environmental impacts.

In February 1976, the original work plan and proposal of the SSMP was revised to reflect the addition of DLD and to resolve the above questions.[3] The work plan and proposal was supplemented in December of 1976 to include the work and costs necessary to complete the EIRs for the SSB and DLD aspects of the program.[4] The February work plan and proposal, including modifications made in subsequent months, and the December work plan and proposal were authorized by the District Board of Directors on January 10, 1977 (Resolution No. SR-121) as Amendment 10 to the agreement for engineering services between the District and SAC.[4a] At this point the SSMP consisted of seven tasks: (1) program management, (2) regulatory agency coordination, (3) source survey Phase 1, (4) SSB studies, (5) DLD study, (6) microbiological and virus studies, and (7) SSB and DLD EIRs. Each task, in turn, has consisted of a certain number of subtasks as discussed later in this chapter. Shortly afterwards, on May 23, 1977, several scope changes and a cost change were authorized by the Board of Directors (Resolution No. SR-144) as Amendment 10A to the District-SAC agreement.[4b] The scope changes consisted of additonal odor surveys for the DLD study, additional heavy metal analysis for the source survey (Task 3), and restructuring the virus surveillance program to include enterovirus monitoring.

Following after the submittal of the Final Report on the Solids Storage Basin Studies - Development of Odor Criteria for Large Emission Areas (Subtask 4.6) - in September 1977,[22] the District expressed serious doubts for the continued use of SSBs in the SSMP. The projected high number of probable evenings of odor occurrences in excess of the accepted property line odor concentration (2 ou/cf) made the risks involved with this liquid state sludge processing alternative seemingly unacceptable. Table 1-1 provides a summary of these probable odor occurrences that were projected at that time.

Then, early in November 1977, SAC SSMP management met with key members of the District staff to review the situation and explore the implementation of other alternatives which might be available

Table 1-1. Estimated Odor Risk for Proposed SSBs Assuming 182.5 Days/Year Inversion

Odor control and dispersion system		Probable number of days/yr[a]		
Sludge condition	Dispersion	2 ou/cf	5 ou/cf	10 ou/cf
Unstripped	Ambient	106	66	43
Unstripped	Wind machines and barriers	57	30	20
Stripped	Ambient	69	33	20
Stripped	Wind machines and barriers	28	15	11
Stripped with digester control	Wind machines and barriers	14	8	7

[a] Number of days on which the given odor concentration will be reached or exceeded for one hour or more at the plant boundary (2,000 ft downwind).

for the disposal of the Regional Plant's sludge. Obviously, if liquid state storage was not acceptable, liquid state disposal was also unacceptable. Without the SSBs as a buffer between the 24 hour per day, 365 day per year sludge production loadings and the 100 day per year land spreading operation, liquid state disposal is impractical. The best alternative to liquid state operation, as documented in previous studies, is anaerobic digestion, dewatering of digested sludge and DLD of the dewatered sludge on-site. It was obvious, however, that a completely satisfactory dewatering alternative could not be implemented until several years after the Regional Plant was scheduled to come on line.

This scheduling problem received considerable attention at this meeting. The possibility of the use of the Regional Plant's screenings, grit, and scum dewatering and incineration facilities in conjunction with the digesters and existing SSBs as an interim alternative for the plant's first five years of operation was discussed. It was believed that with some relatively minor additions and modifications to the dewatering and incinerator facilities already under construction, their capabilities could be enlarged to accommodate all of the plant's wastewater solids during the interim 2-3 year period required to have permanent dewatering facilities on line.

On December 15, 1977, another meeting was held between the District staff and SAC. At this time SAC presented the alternative costs for the use of the Regional Plant screenings, grit and scum dewatering and incineration facilities and the ramifications of their use on (1) the existing construction contract, (2) future sludge processing and disposal construction and operation costs, and (3) existing air pollution regulatory restrictions. To determine these ramifications, SAC had to develop new up-to-date wastewater solids loading figures for the Regional Plant based on the elimination of chemical treatment from the combined stormwater control system and the decision to exclude West

Sacramento from the regional system. These new figures were developed for screenings, grit, scum, primary sludge, secondary sludge, and stormwater sludge for annual average, maximum seasonal, wet weather maximum, seasonal peak and wet weather peak conditions for the years of 1980, 1985, 1992 and 1999. With these new loading figures, the various alternatives of dewatering, incineration, digestion and existing SSB use for these regional facilities were studied by computer.

While work was proceeding on the development of these interim dewatering and incineration alternatives, additional efforts were being made to determine if there was any means of mitigating the high number of odor occurrences reported in the large area emission study (Table 1-1). These efforts involved further discussions with Eutek, subcontractor to SAC on the odor studies, on means of controlling digested sludge volatility, which was found to be extremely variable in the SSB source odor control study[20] and the SSB's experimental work,[15] and more definitive work on the micrometeorological conditions which affect the dispersion of SSB surface odor emissions. During this period of time, Dr. George Wilson of Eutek reported on some findings from his company's recent work at Los Angeles County's sludge composting operation. This work had been conducted during the fall months (August through October) of 1977 and involved the monitoring of the micrometeorological conditions at their composting site.

The findings, which were important to the large area odor emission work in Sacramento, involved the number of occurrences of inversion conditions at the site. Instead of finding inversion conditions 50 percent of the time, as assumed from the earlier and admittedly limited data at the Sacramento site, (Table 1-1) it was found these conditions took place more like 1.5 to 8.5 percent of the time. If this same condition was representative of Sacramento conditions, the number of odor occurrences per year which exceed the property line limit of 2 ou/cf would be reduced from 14 to 1.1 (see Table 1-2). The new information, when combined with the observations that if the same odor occurrence assumptions (182.5/ year) were applied to the existing 40-acre SSB operation, there would have been 20 occurrences in 1977 of property line odor concentrations in excess of 10 ou/cf nuisance limit (see Table 1-3), when no actual complaints were traceable to the SSB's, renewed the District's confidence in the use of the SSB's and the liquid state processing and disposal alternative for Regional Plant sludge.

Review of the costs, construction contract ramifications and air pollution permit changes to the Regional Plant, the impacts on permanent sludge processing and disposal costs, and renewed possibility of liquid state storage acceptance resulted in the following conclusions; (1) nothing should be done to the Regional Plant screening, grit and scum dewatering and incineration facilities presently under construction to provide interim dewatering capabilities; (2) every effort should be made to determine, prior to completion of the EIR if additional site specific information confirms a significant reduction in the probable number of odor occurrences from the SSBs; (3) interim SSB capacity, sufficient to assure aerobic surface layer operation until alternative dewatering facilities can be built, should be included in the dewatering alternative to be developed for the EIR and (4) the separate SSB EIR and DLD EIR should be combined into a single SSMP EIR which should be completed in October of 1978. Figures 1-1 and 1-2 present the timetables for implementation of the two major sludge processing and disposal alternatives which were subsequently evaluated in the SSMP EIR.[42] At the end of this meeting SAC was instructed to develop additions and revisions to the SSMP program which would support these four conclusions.

On January 5, 1978, SAC met with District staff to review the changes proposed for the SSMP to implement the December 15, 1977 conclusions. During the period between December 15 and January 5,

Table 1-2. Estimated Odor Risk for Proposed SSBs Assuming 30 and 5 Days/Year Inversion

Inversion assumption, days/yr	Odor control and dispersion system		Probable number of days/yr[a]		
	Sludge condition	Dispersion	2 ou/cf	5 ou/cf	10 ou/cf
30	Stripped with digester control	Wind machines and barriers	2 1/2	1 1/2	1 1/5
5	Stripped with digester control	Wind machines and barriers	1/2	1/4	1/5

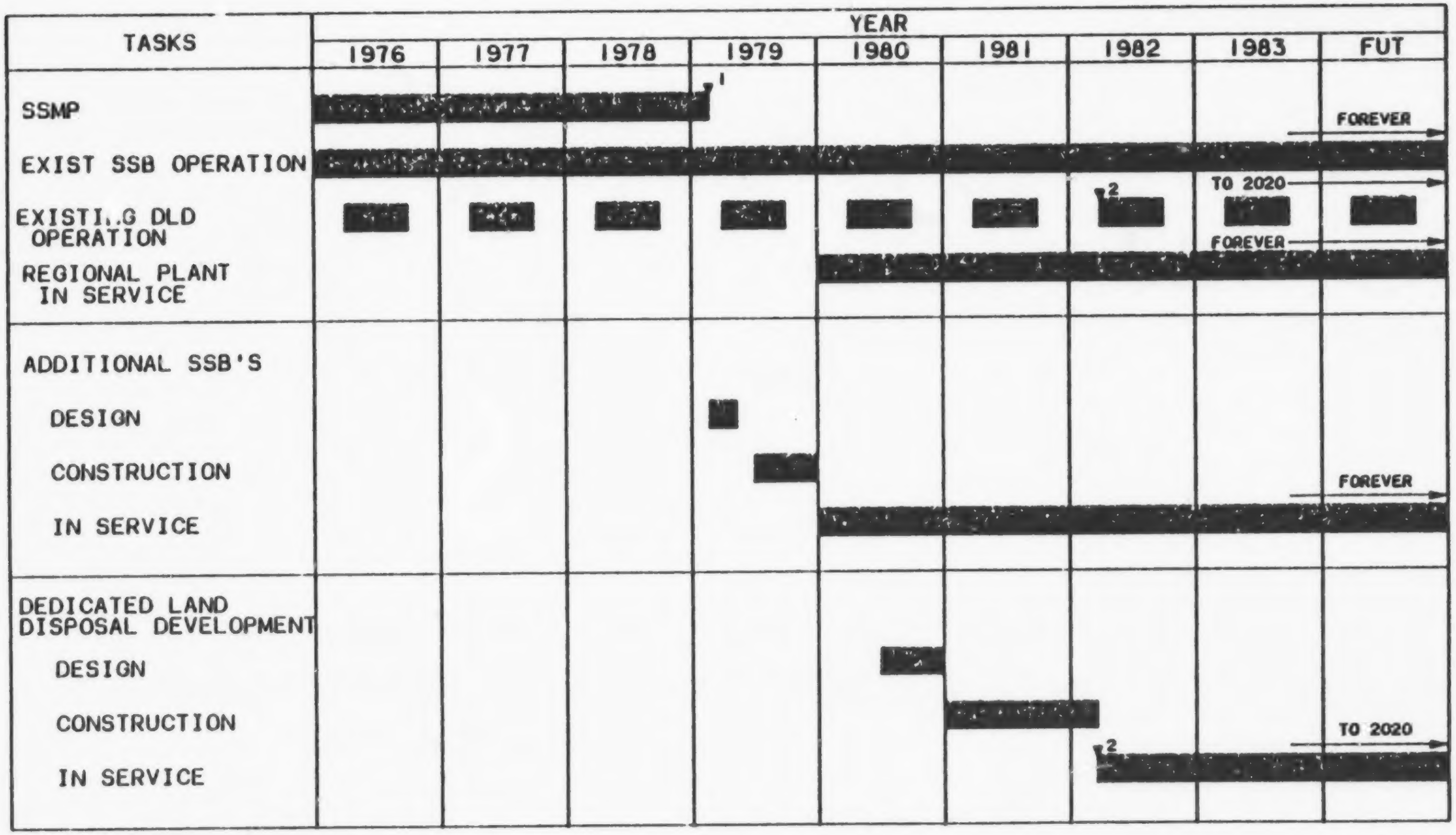
[a] Number of days on which the given odor concentration will be reached or exceeded for one hour or more at the plant boundary (2,000 ft downwind).

Table 1-3.. Estimated Odor Risk for Existing SSBs Assuming 182.5, 30 and 5 Days/Year Inversion

Inversion assumption, days/yr	Odor control and dispersion system		Probable number of days/yr[a]		
	Sludge condition	Dispersion	2 ou/cf	5 ou/cf	10 ou/cf
182.5	Unstripped	Ambient	57	33	20
30	Unstripped	Ambient	9	5	8
5	Unstripped	Ambient	1 1/2	1	1/2

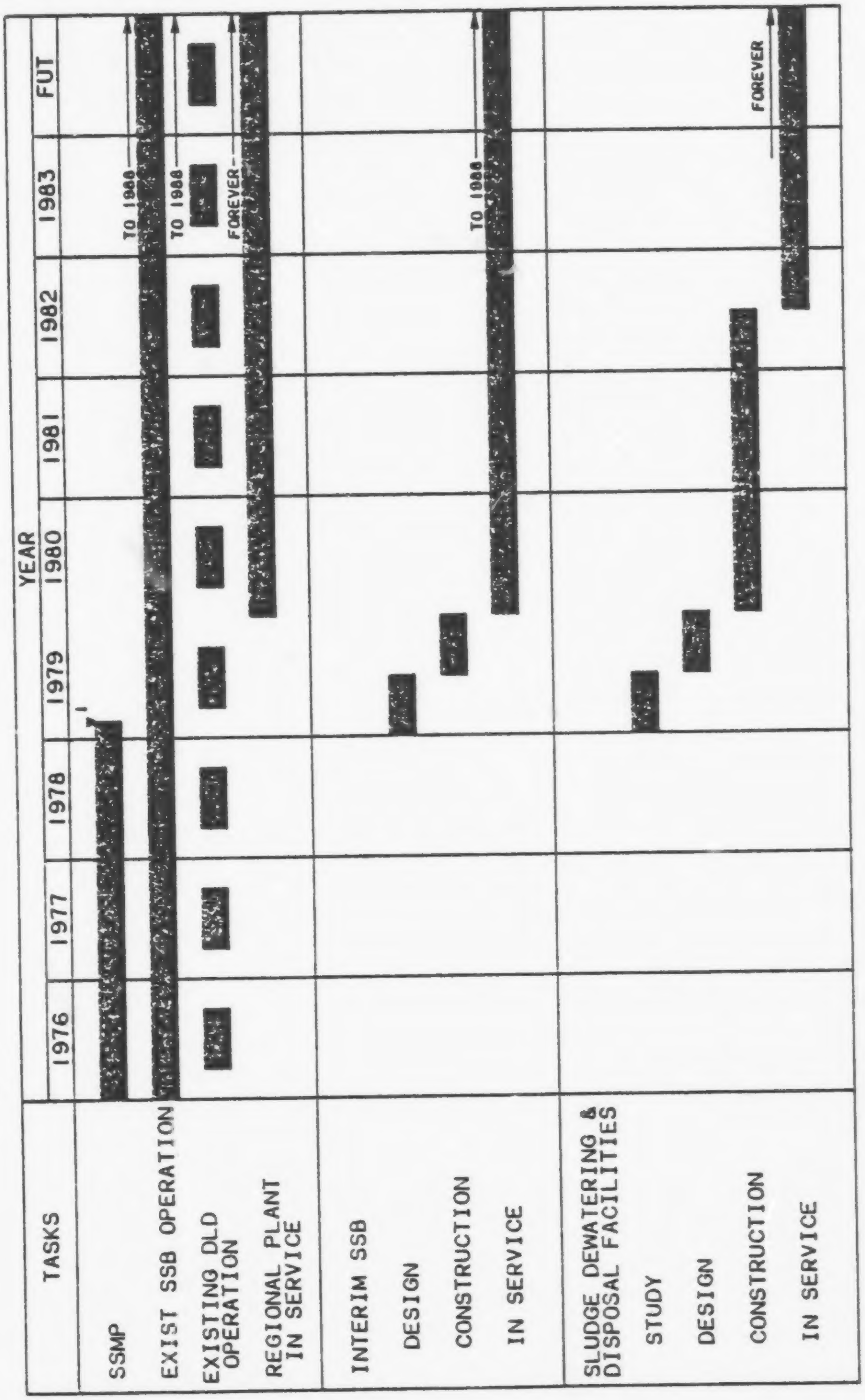
[a] Number of days on which the given odor concentration will be reached or exceeded for one hour or more at the plant boundary (2,000 ft downwind).

Fig. 1-1 Timetable for Implementation of the SSB-DLD Alternative



1. E. I. R. APPROVED
2. SSB HARVEST INCREASED TO 30,000 DRY TONS/YEAR

Fig. 1-2 Timetable for Implementation of the Dewatering Alternative



1. E. I. R. APPROVED

four basic decisions were made by the District which affected these proposed changes. First, the District indicated they believed time or cost constraints would not tolerate any additional digested sludge volatility studies. Basically this confirmed their conclusion that the gains in assessing the potential environmental risks from having better odor dispersion information far exceeded any gains which might have developed from reducing odor emission rates. Second, the District wished to finance, as much as possible, the additional SSB studies within the existing SSMP budget and were prepared to transfer some sludge spreading costs and SSB and DLD monitoring costs to the District operations and maintenance budget for the Central Wastewater Treatment Plant to accomplish this goal. Third, the District wished to construct barriers and provide wind machines for the existing SSBs. These barriers and wind machines were to be in service by August 1978. Fourth, the District wished to start immediately to implement the necessary permits to support their interim and, eventually, their permanent sludge disposal system to dedicated land at the treatment site.

As a result of the material presented to the District at this January 5, 1978 meeting and the discussions held on this material, SAC prepared, or had prepared, descriptions of the SSMP revisions, proposals, and authorization requests for the additional work required to implement all of the changes requested. The 1977 status report and these recommended program revisions were submitted at the SSMP progress seminar on February 9, 1978.[6] These revisions, together with all necessary documentation, were formally submitted to the District for approval on May 30, 1978.[7] The May 30 program revisions as well as proposals from 1977 for the determination of heavy metal migration from SSBs and for a special odor evaluation of emergency storage basin (ESB) operation, were authorized by the District Board of Directors on July 11, 1978 (Resolution No. SR-282) as Amendment 10B to the District-SAC agreement.[7a]

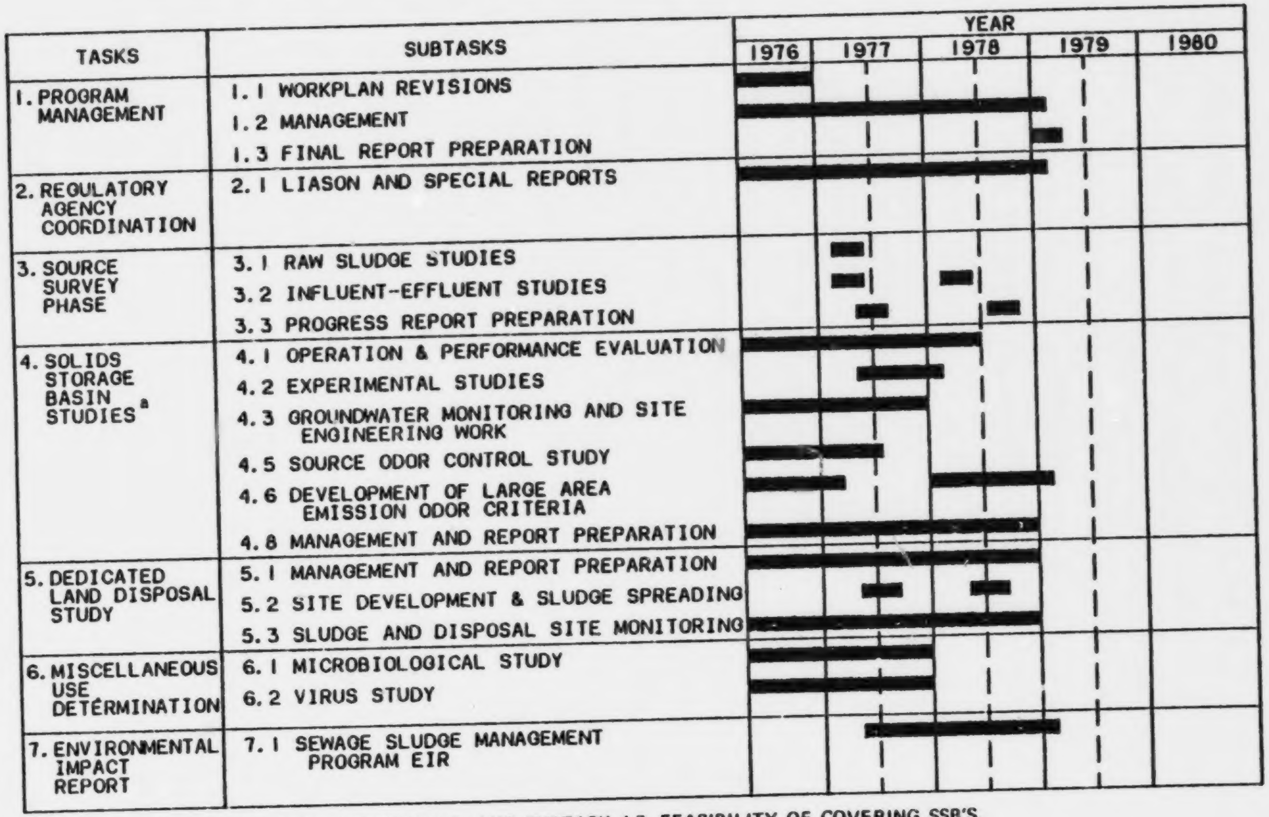
Subsequent to the May 30 submittal, six scope and cost changes were authorized by the District. The first five changes were authorized by the District Board of Directors on December 11, 1978 (resolution No. SR-326) for additional engineering services relative to SSB-DLD site planning and geotechnical investigations, topographic mapping, feasibility study of surface sludge spreading systems, DLD soils monitoring and additional EIR work.[8] The most recent scope change was January 9, 1979,[9] authorizing SAC to perform the DLD soils and soil solution sampling and analysis for 1979 which had been transferred to District operations in the May 30, 1978 SSMP revised work plan.

Description of Work

As indicated in earlier discussion, the SSMP has consisted of seven tasks. Figure 1-3 lists the tasks along with the various subtasks and a time period during which the work in each subtask was conducted. The remainder of this chapter is devoted to a brief description of this work and an updated review of program costs. Chapter 2 reviews the SSMP studies that have been completed and provides a summary of the more important results obtained. Chapter 3 reviews the conclusions of the SSMP and discusses the remaining work to be completed prior to start-up of the Regional Plant.

Program Management. Program management was an on-going task in the SSMP and involved the following three subtasks; 1) authorization preparation and all preparatory work done on other subauthorizations prior to formal acceptance of the SSMP, 2) management of the entire SSMP including the maintenance of monthly significant action reports, supervision of the work in the other tasks, formulation of program revisions and preparation of annual interim reports, and 3) preparation of the final SSMP report.

Fig. 1-3 Sewage Sludge Management Program Schedule



a. SUBTASK 4.4, DIURNAL ODOR MONITORING, AND SUBTASK 4.7, FEASIBILITY OF COVERING SSB'S, WERE COMPLETED PRIOR TO 1976

Regulatory Agency Coordination. In a project such as the SSMP which has spanned a period of several years, continued regulatory agency coordination has been extremely important. This coordination has involved 1) attending regulatory agency briefings on new regulations, 2) assuring that regulatory agencies are kept fully informed of the purposes and findings of the sludge management program, 3) attend regulatory sponsored sewage sludge disposal seminars, and 4) prepare special material to support District policies and needs in dealing with proposed agency regulations.

Source Survey. The source survey, task 3 of the SSMP, was composed of Phase 1 and Phase 2 studies which were conducted during 1977 and 1978, respectively. Phase 1 consisted of three subtasks; 1) raw sludge studies, 2) influent-effluent studies, and 3) the preparation of progress reports. The purpose of Phase 1 was to determine which existing treatment plants within the Regional District were receiving excessive levels of heavy metals and chlorinated hydrocarbons. This was accomplished through an intensive monitoring program of raw sludge from ten District supervised treatment plants and the influent and effluent from the City Main and Central wastewater treatment plants. Based on recommendations of the Phase 1 source survey progress report,[11] additional sampling and analytical work were undertaken during Phase 2 to identify the sources of unusual concentrations of heavy metals discharged into the sewer systems tributary to six of the ten plants examined in Phase 1.

Solids Storage Basin Studies. Task 4 of the SSMP consisted of a series of eight subtasks which were designed to supply precise SSB operational and design criteria and to provide assurance that the basins can meet every conceivable environmental limitation. In subtasks 4.1 and 4.2 various modes of SSB loading and mechanical surface mixer operation were evaluated along with intensive monitoring programs which monitored basin surface layers, solids buildup and the chemical characteristics of the supernatant and stored sludge. The effect of SSBs on local groundwater was addressed in subtask 4.3 through a regular monitoring program of SSB groundwater and two detailed studies on the bottom permeability of tne basins. The thrust of subtasks 4.4 to 4.7 was odor control. Specific odor criteria were set as design objectives for the Regional Plant and various mitigation measures were evaluated for their effectiveness in reducing odor risks to meet the design objectives. Mitigation measures evaluated included stripping of odors from digested sludge, and barriers and wind machines to induce dispersion. The feasibility of providing covers for the basins was also studied. The final subtask, 4.8, involved the management and coordination, preparation of quarterly data summaries and the preparation of interim and final reports.

Dedicated Land Disposal Study. The dedicated land disposal study, Task 5, study was designed to evaluate various methods of applying SSB stabilized sewage sludge to land dedicated exclusively for such use and monitoring the effects on soil, groundwater and surface water. For purposes of the study, work was divided into the following three subtasks; 1) management and report preparation, 2) site development and sludge spreading, and 3) disposal site monitoring. Methods of sludge application which have been evaluated include subsurface injection, and ridge and furrow, flooding, and surface spreading and tillage.

Miscellaneous Use Determinations. Task 6 of the SSMP consisted of microbiological and virus studies to determine how the proposed storage and final disposal would affect the sludge pathogen level. Determining the bacteria, parasite and virus counts through the sludge treatment and disposal process allowed a public health assessment to be included in the SSMP EIR on the various post-digestion sludge alternatives considered. The work was cut short at the end of 1977 to assure adequate financing for additional SSB odor studies. Data collected prior to this cut off date is believed to be conclusive evidence of the viability of long-term storage for pathogen level control.

Environmental Impact Report. The EIR was the final task of the SSMP. The purpose of this EIR was to compare and contrast the environmental, social, economic and engineering considerations of several post-digestion sludge alternatives to assure that the most cost-effective and acceptable solution would be undertaken and that adequate safeguards would be included in the recommended project design and operation.

Program Cost

Table 1-4 presents an updated cost summary for the SSMP by task. In preparing this cost summary, reference was made to the cost summary contained in the SSMP recommended program revisions of May 30, 1978.[7] This previous cost summary was updated to reflect the cost additions contained in the District authorized scope changes of December 11, 1977[8] and January 9, 1979.[9] Total estimated cost for conducting the SSMP was approximately $2.5 million, which is entirely grant eligible. Of this amount, $1,922,330 was budgeted for the SSB and DLD studies. Odor work, subtasks 4.4 through 4.7, demanded the largest share of the SSMP budget at approximately $1,014,870. The total cost does not reflect costs incurred directly by the District for rental and purchase of equipment, sampling and analysis, construction of barriers, engineering and administration.

Table 1-4. SSMP Cost Summary

Task	Description	Estimated cost, dollars
1	Program management	163,400
2	Regulatory agency coordination	9,200
3	Source survey, Phase I and II	48,550
4	Solids storage basin studies[a]	1,334,000
5	Dedicated land disposal study	588,330
6	Miscellaneous use determinations	83,450
7	Environmental impact report	251,410
	Total[b]	2,478,340

[a] Includes $63,000 for diurnal odor studies (Subtask 4.4) and $3,500 for SSB covering feasibility study (Subtask 4.7) which were completed prior to the February 17, 1976 initiation of the SSMP.

[b] Does not include costs incurred directly by the District for rental and purchase of equipment, sampling and analysis, construction of barriers, engineering, and administration.

CHAPTER 2

REVIEW OF SSMP STUDIES

Planning for the Sacramento Regional Wastewater Management Program (SRWMP) has been actively proceeding since the early 1970's. The SSMP, a major segment of the Regional Program, has been conducted over the past three years with the primary objective, through actual full-scale field evaluation, of developing precise operational and design criteria for the SSB-DLD system, and through intensive monitoring programs, of providing assurances that the proposed system can meet every conceivable environmental concern.

Odor risk associated with the SSBs has been the major obstacle to be overcome. An unparalleled effort was undertaken, as part of the SSMP to thoroughly investigate this topic. Early in the SRWMP the District adopted specific odor criteria as design objectives for the Regional Plant. As part of the SSMP, extensive studies were conducted on odors created during the operation of the SSBs and of the effectiveness of mitigation measures in reducing the odor risk to an acceptable level. The certification of the SSMP EIR by the District Board of Directors on January 22, 1979 indicates that the SSBs, with the appropriate mitigation measures, are now viewed as an acceptable odor risk, and together with DLD, can be confidently incorporated into the Regional Plant's solids processing and disposal system.

The SSMP subtasks outlined on Figure 1-3 have generated a tremendous amount of data which has been summarized and evaluated in various task reports. The purpose of this chapter is to present some of the more important information that has been produced. A more detailed and thorough consideration of any topic can be found in the appropriately referenced task report.

REGULATORY AGENCY COORDINATION

Task 2 of the SSMP, regulatory agency coordination, did not involve the preparation of task reports, but is discussed in this chapter to emphasize the importance that this type of task has in a sludge program. Regulatory control over sludge disposal is a rapidly evolving and expanding field which requires keeping appraised of all relevant sludge regulations, as well as continued coordination with regulatory agencies. Table 2-1 was prepared to illustrate the degree of regulatory control which exists over the implementation of Sacramento's SSB-DLD system. As many as fourteen approvals or permits may have to be acquired for construction of Phase 1 facilities which consists of eight SSBs and one DLD site.

SOURCE SURVEY

Heavy metals and chlorinated hydrocarbons (including polychlorinated biphenyls) are recognized by regulatory agencies as major deterrents which can restrict the eventual reuse of sludge on agricultural land. In sufficient concentration these contaminants may also adversely affect both the liquid and solids treatment processes. Fortunately, however, they are probably the most easily traced and therefore subject to practical source detection and elimination.

The 1975 Solids Study[1] recognized the necessity to determine, as quickly as possible, if some relatively economical means of source control could affect the present levels of heavy metals and chlorinated hydrocarbons in the existing systems. In developing the work plan for the Source Survey, it was realized that the most logical, efficient and rapid means of detection of unusually high levels of these toxic materials in various areas of the system

Table 2-1. Permits and Approvals Neccessary to Implement the SSB-DLD Project

Agency	Approval	When needed
California Regional Water Quality Control Board, Central Valley Region	Waste discharge requirements	Prior to construction
State Department of Water Resources	Dam safety permit may be required depending upon SSB water volume above grade	Prior to construction
U. S. Army Corps of Engineers	Section 404 permit for filling wetlands	Prior to construction
State Department of Fish and Game	Stream Alteration permit and filling of wetlands	Prior to construction
State Solid Waste Management Board	County Solid Waste Management plan amendment	Prior to construction
State Solid Waste Management Board	Conformance with County Solid Waste Management Plan	Prior to construction
State Solid Waste Management Board	Landfill operating permit	Prior to operation of disposal facilities
County Division of Water Resources	Approval for modifications to Morrison Creek floodplain	Prior to construction
County Water Agency	Approval for drainage modifications	Prior to construction
County Planning Department	Special use permit	Prior to construction

would be to examine the raw primary and secondary sludge of the existing treatment plants. The concentration of solids in the raw sludge acts as a multiplier which helps to magnify differences which might otherwise go undetected and as a retainer which assures that single daily grab samples reflect, as much as possible, most of the material entering the system each day.

However, while raw sludge sampling provides an excellent means of monitoring for excessive heavy metals or persistent organics in system solids, it does not provide the interrelationships between what is separated as solids and what is actually entering the treatment plant. To determine this information requires the examination of the contents of a plant's influent and effluent heavy metal and chlorinated hydrocarbon levels in relationship to the level of similar materials found in its raw sludge. This interrelationship information also provided a check on the validity of the assumption that daily grab samples of raw sludge are representative of the entire day's solids inflow.

Phase 1

Phase 1 the SSMP Source Survey was designed to determine which existing treatment plants within the District's boundaries were receiving excessive levels of heavy metals and chlorinated hydrocarbons. Recommendations resulting from Phase 1 were contained in a task report for this study[11] and formed the basis for conducting the Phase II portion of the survey.

Objectives. Phase 1 of the survey was composed of three subtasks. The objectives of these subtasks were as follows:

1. To determine if any of ten District supervised plants were receiving higher than normal domestic levels of heavy metals or chlorinated hydrocarbons.

2. To establish whether City Main and Central wastewater treatment plants influent and effluent levels of metals and organics could be related to the raw sludge levels determined in Task 1; this task was also intended to obtain information on plant removal efficiency of metals and organics.

3. To determine, based on review of data from Tasks 1 and 2, which treatment plants were receiving abnormally high levels of either heavy metals or chlorinated hydrocarbons and to compare the heavy metal and chlorinated hydrocarbons concentrations found to the findings of similar investigations in other municipalities.

Sample Collection Procedure. Ten District wastewater treatment plants were monitored during Phase 1 of the Source Survey. These plants included Northeast, Rancho Cordova, Arden, Highland Estates, Rio Linda, CSD #6, Natomas, Central, Meadowview and City Main. Two of these plants, City Main and Central, ultimately receive the sludge from 97 percent of the sewered population within the District's boundaries.

Raw sludge samples were collected daily for five weeks (April 17 to May 21, 1977) from the ten treatment plants listed above. At two of these plants, Central and City Main, influent and effluent samples were also collected. Composites were made of each weekly series of samples and these were analyzed for arsenic, beryllium, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, silver, zinc and chlorinated hydrocarbons. Portions of each daily sample were placed in freezer storage for subsequent analysis if necessary.

Results. A tremendous amount of data was obtained from the Phase 1 sampling program. A comparison of the heavy metal loads in the raw sludges of the ten sampled plants revealed that Northeast, Highland Estates, CSD #6 and Meadowview receive only domestic levels of heavy metals. Rancho Cordova, Arden, Rio Linda, and Natomas plants, although predominantly residential, do serve some light industries and commercial establishments. Total heavy metal loads to these plants were found to be generally domestic in character but there were some periodic abnormal discharges of some heavy metals.

A range of domestic per capita loads was developed for each heavy metal based on data from Northeast, Highland Estates, CSD #6, and Meadowview treatment plants. Metal concentrations in the raw sludge in the highest week and lowest week from any of the four plants was selected to define a range of metal concentrations characterized by domestic wastewater sludges. These concentrations were converted to a per capita load for each heavy metal. The domestic unit loads were used to develop an estimated total domestic load to determine which plants receive excessive discharges of heavy metals.

Ratios of average plant heavy metal loads, as measured in the raw sludges, were calculated and compared to the plant's estimated domestic load. The ratios are categorized in Table 2-2 by the following criteria which reflect the degree the quantities of heavy metals are in excess of estimated domestic loads.

1. Not significantly in excess
2. Moderately in excess
3. Greatly in excess

This table also indicates which of the heavy metals have an identified source. The identified sources are among those industries that are currently monitored by the Sacramento County Industrial Waste Section. For the Central plant, the currently monitored industries appear to be the sources of the measured heavy

Table 2-2. **Summary of Ratios of Plant Loads to Estimated Domestic Loads**

Heavy metal	Classifications of heavy metal loads					
	Central	City Main	Rancho Cordova	Arden	Rio Linda	Natomas
Arsenic	1	3B	2A	1	3B	3B
Beryllium	1	1	1	1	1	1
Cadmium	2A	1	1	1	1	1
Chromium	2A	3B	1	1	3B	1
Copper	1	3B	1	1	3B	1
Lead	1	3B	1	1	2B	1
Mercury	1	2A	1	1	2B	1
Molybdenum	1	1	1	1	1	1
Nickel	1	3B	1	1	2B	1
Selenium	1	1	1	1	1	1
Silver	1	3B	1	3B	2B	1
Zinc	1	2A	1	1	3B	1

Definitions of Classifications

Class. 1	Heavy metal load not significantly in excess of domestic levels (ratio less than or equal to 2).[a]
Class. 2	Heavy metal load moderately in excess of domestic levels (ratio between 2 and 3.5).[a]
Class. 2A	Load accounted for by currently monitored industries.
Class. 2B	Load not accounted for by currently monitored industries.
Class. 3	Heavy metal load greatly in excess of domestic levels (ratio greater than 3.5).[a]
Class. 3A	Same as 2-A (above).
Class. 3B	Same as 2-B (above).

[a] Ratio of average plant load (for five weeks sampled) to estimated domestic load based on raw sludge data (Table -1).

metal load. For the City Main plant, however, the currently monitored industries do not account for the measured heavy metal loads.

Chlorinated hydrocarbons were also measured in the raw sludges, influents, and effluents on the same schedule as heavy metals. It was determined that there is no consistent detectable load of chlorinated hydrocarbons in domestic wastewaters. Concentrations of chlorinated hydrocarbons in Central and City Main were compared to the Proposed Primary Drinking Water Standards in the Phase 1 task report, and in all but one week the measured concentrations in Central and City Main influents were significantly less than the standards. Similarly, the concentrations of chlorinated hydrocarbons in the raw sludges were low enough to qualify the sludge as a Class I sludge as described by the California State Department of Health.

Conclusions and Recommendations. The following conclusions were drawn from Phase 1 of the Source Survey:

1. Central and City Main heavy metal loads were in excess of domestic loads.

2. Central heavy metal loads could generally be accounted for by measured loads in effluents of currently monitored industries.

3. City Main heavy metal loads could not generally be accounted for by measured loads in effluents of currently monitored industries.

4. Periodically, excessive loads of one or two heavy metals were detected in the raw sludges of Rancho Cordova, Arden, Rio Linda and Natomas.

Recommendations for continuation of the SSMP Source Survey were limited to those tasks which would help identify the principal sources of heavy metal and chlorinated hydrocarbons discharges to the District collection system, and which would more accurately determine the magnitude of these discharges. Only after the magnitude and sources of the discharges have been documented can it be determined whether it is appropriate and cost-effective to undertake source control programs for heavy metals or chlorinated hydrocarbons. Source control measures must, of course, be considered in relation to the impact they have on industry, Regional Plant effluent and final sludge disposal.

The following tasks were recommended in the Phase 1 survey report for completion in Phase 2; much of the work was to be conducted by the Sacramento County Industrial Waste Section:

1. The currently unidentified sources of arsenic, chromium, copper, lead, nickel, and silver discharged to the City Main system should be identified. Plating industries are a potential source of these heavy metals. Additional monitoring, including measurement of the quantity of wastewater from these industries, is needed.

2. Sampling programs should be designed to verify that the suspected sources of heavy metal discharges to Central plant are accurate. It appears that Campbell Soup Company may be the principal source of excessive levels of cadmium and chromium measured at Central plant. Confirmation of this will require coordinated sampling of Campbell Soup effluent and Central influent.

3. Sources of arsenic at Rancho Cordova and Natomas should be investigated as should sources of heavy metals at Rio Linda. However, the masses of heavy metals discharged to Rancho Cordova, Arden, Rio Linda, and Natomas, does not represent a major regional source when considered in relation to the overall regional system loads.

4. Analysis of some daily samples of raw sludge, influents and effluents in freezer storage should be performed. These analyses should indicate whether the abnormal discharge was relatively constant or variable through the week. Only two sets of samples merit reanalysis at this time:

   a. Daily effluent samples at City Main for all five weeks measured higher concentrations of lead and nickel than the influent, and, therefore, the influent and effluent samples should be reanalyzed for lead and nickel.

   b. Raw sludge and influent daily samples at Central for weeks 3 and 4 should be reanalyzed for cadmium and chromium to see if they reflect peak day discharges or high levels for the entire week.

Phase 2 Survey

The implementation of the Phase 1 recommendations was limited due to the promulgation of "General Pretreatment Regulations for Existing and New Sources of Pollution" by the EPA. These new regulations call for a much more extensive source identification and monitoring program than had been scoped for the Phase 2 Source Survey. Additionally, grant funds would be allocated for development of the Pretreatment Program. Therefore, it was recommended that only the analysis of selected stored daily samples task of the Phase 2 Source Survey be implemented.

This implementation involved the analysis of the 35 consecutive days of wastewater treatment plant stored daily influent and effluent samples from the City Main plant for nickel and lead and the daily raw sludge samples for weeks 3 and 4 from the Central wastewater treatment plant for cadmium. A review draft report was submitted on this work on June 5, 1979.[11a] The final reports on Phase 1 and 2 were subsequently issued in September, 1979.[11b]

At City Main, the data showed little or no removal of lead and a twofold increase in nickel through the treatment process. This increase in nickel is probably due to ferric chloride additions for sludge dewatering. Ferric chloride solution contains varying amounts of both nickel and lead. The nickel and lead loads in the City Main influent varied within a fairly constant range except for a single day when a nickel slug load must have been discharged.

Daily raw sludge samples from Central treatment plant for weeks 3 and 4 showed a massive discharge of cadmium to Central treatment plant on one day. The cadmium concentrations preceding the slug ranged from 1.5 to 4.8 mg/kg and the slug was 480 mg/kg. It took about a week for the raw sludge concentrations to drop below 10 mg/kg. This was probably due to a residual in the interceptor or in the primary sedimentation tank.

The data collected in Phase 1 and Phase 2 of the SSMP Source Survey and that being collected in the Toxic Pollutant Survey, will be invaluable in developing a pretreatment program and in responding to pending development of more stringent discharge requirements for toxic pollutants.

SOLIDS STORAGE BASIN STUDIES

Evaluation of SSB operation and performance has been a major component of the SSMP over the past three years. Currently, there are eight SSBs with 40 acres of surface area in operation at the Sacramento Central Wastewater Treatment Plant. The location of these basins, as well as eight groundwater monitoring wells and five sampling sites for Morrison Creek water in relation to the Regional plant site, is shown on Figure 2-1. The location of the pilot odor control facilities and the existing 20-acre DLD experimental site are also portrayed on the figure as well as Phase 1 and 2 SSB-DLD development. Future SSB-DLD development is discussed in Chapter 3 of this report.

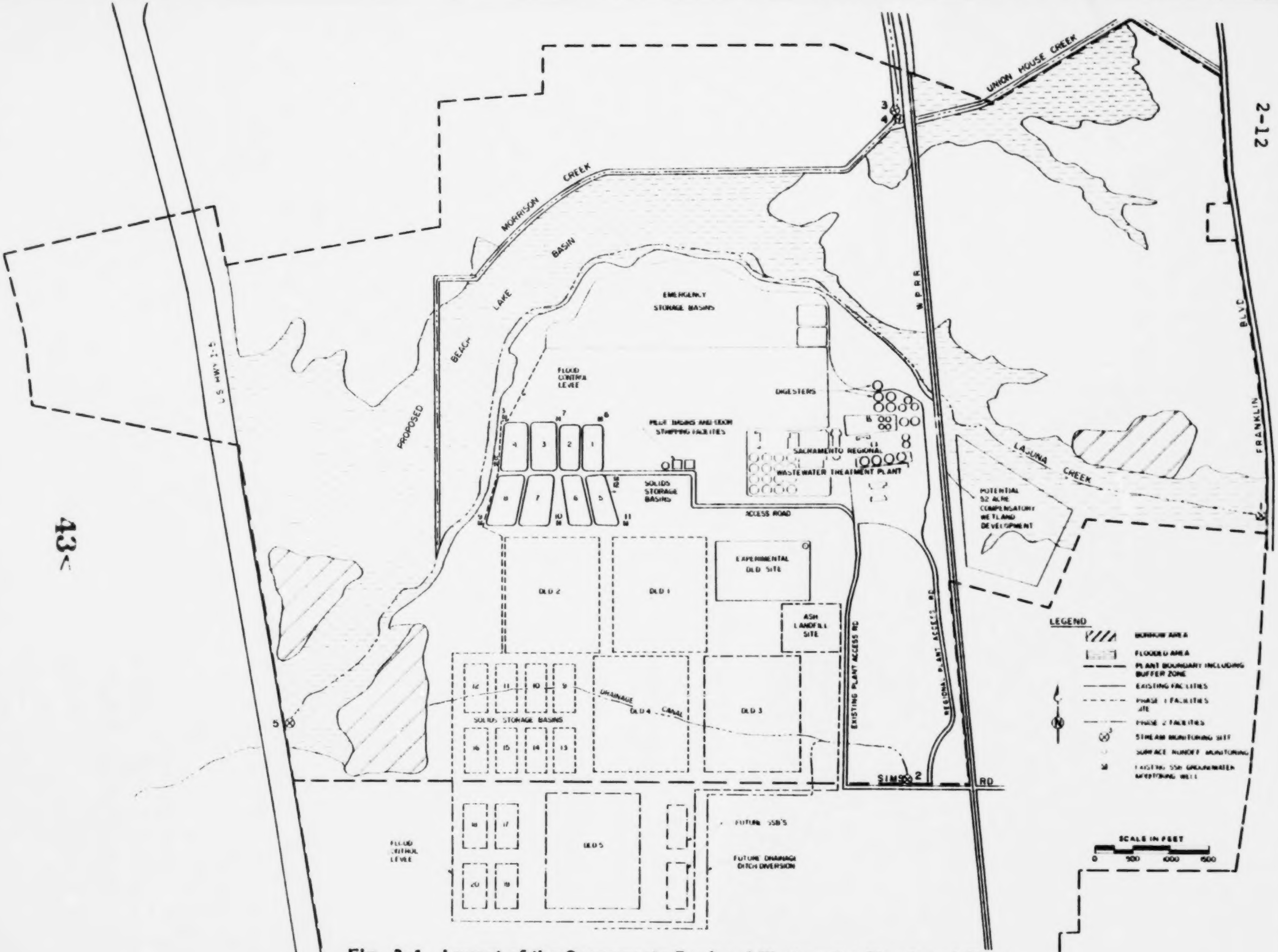


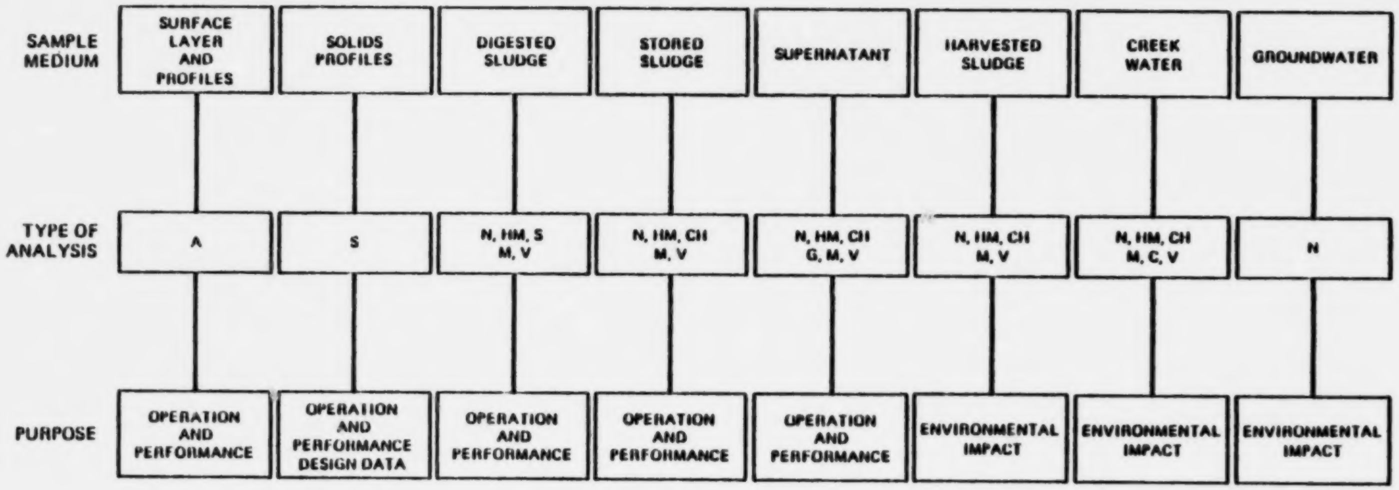
Fig. 2-1 Layout of the Sacramento Regional Wastewater Treatment Plant

SSBs are deep facultative basins which provide the required buffer between the continuous sewage sludge stabilization process (anaerobic digestion) and the time-limited disposal system (DLD). SSBs provide additional stabilization beyond that provided by anaerobic digestion. Maintenance of an aerobic surface layer has been shown to be essential to the successful operation of a basin. This layer serves to minimize odor problems because many of the liquid and gaseous anaerobic decomposition products, carried to the surface by mixing currents, are utilized by the aerobic organisms. Dissolved oxygen (DO) in the SSB surface layers is supplied primarily by algal photosynthesis with some additional help from the scum-control mechanical surface mixers.

The SSB studies were composed of eight subtasks as shown on Figure 1-3. These studies, as discussed below, have been directed towards the evaluation of basin operating and design parameters and the principal environmental concerns consisting of odor production, groundwater and surface water degradation. A summary of the monitoring program used for evaluating SSB operation and performance is shown on Figure 2-2. Portions of other tasks in the SSMP are represented on the figure because of their importance to the SSB studies.

Evaluation of SSB Operation and Performance

The evaluation of SSB operation and performance, subtask 4.2, has been an on-going subtask of the SSMP and has resulted in the preparation of two annual reports and a final report.[29,30,31] A large segment of this subtask has been an intensive monitoring program which not only has allowed a day to day appraisal of the relative condition of the basins, but also allowed a continuing evaluation of their operational and performance capabilities. Investigative work conducted in this subtask has involved the evaluation of various modes of basin loading and mixer operation, and the continuing assessment of the design of the existing SSBs as it relates to overall operational efficiency.



SAMPLE MEDIUM	SURFACE LAYER AND PROFILES	SOLIDS PROFILES	DIGESTED SLUDGE	STORED SLUDGE	SUPERNATANT	HARVESTED SLUDGE	CREEK WATER	GROUNDWATER
TYPE OF ANALYSIS	A	S	N, HM, S M, V	N, HM, CH M, V	N, HM, CH G, M, V	N, HM, CH M, V	N, HM, CH M, C, V	N
PURPOSE	OPERATION AND PERFORMANCE	OPERATION AND PERFORMANCE DESIGN DATA	OPERATION AND PERFORMANCE	OPERATION AND PERFORMANCE	OPERATION AND PERFORMANCE	ENVIRONMENTAL IMPACT	ENVIRONMENTAL IMPACT	ENVIRONMENTAL IMPACT

LEGEND:

A	–ALGAE, EC, TURBIDITY, TEMP, pH, H_2S, DO
S	–TS, VS
N	–NUTRIENTS
HM	–HEAVY METALS
M	–MICROBIAL
V	–VIRUS
CH	–CHLORINATED HYDROCARBONS, PCBs
G	–BOD, COD, SS
C	–COLIFORMS

Fig. 2-2 Summary of 1977 Monitoring Program for Evaluating SSB Operation and Performance

Surface Layers and Odor Production. Monitoring of basin surface layers during the past several years has been directed towards gaining insight into the interrelated components of a successfully operating facultative SSB. Surface layer parameters include algae count, DO, temperature, turbidity, electrical conductivity (EC), pH and hydrogen sulfide. Other parameters include average daily sunshine, mode of mixer operation, and volatile solid (VS) loading rate.

In the final analysis, odor is the criterion in determining the successful operation of an SSB. A number of factors, including operational parameters and surface layer characteristics, have been found to be important in the control of surface odor emissions. In order to minimize the potential for odor generation, it is essential to maintain DO concentrations and high pH levels in the surface layers. Critical to the achievement of these goals is the presence of an actively growing algae population which, at the Central plant SSBs, has continually been Chlorella, a unicellular green species of algae. In a nutrient-rich environment such as in an SSB, surface layer temperature and available sunlight are determining factors in the growth and reproduction of algae. As discussed later in this chapter, mechanical surface mixer operation is essential for long-term, odor-free SSB operation. Excessive basin overloading must be avoided, otherwise surface accumulations of scum and solids will appear, surface layer DO will be totally utilized, sulfide production will increase and odors will result.

Solids Concentration and Volatile Solids Reduction. One of the major attributes of SSBs is that they function essentially as secondary digesters. Over time, there is a continual reduction in volatile solids (VS) which reduces the amount of stored sludge that has to be disposed of in the future. Furthermore, SSBs actively concentrate sludge. The 1976 annual report included data which showed that SSB 4, for example, had 19 percent solids concentration in its bottom layer after having been fed with anaerobically digested primary and waste activated sludge with a concentration of less than 2 percent solids for two years.[29]

Solids profiles of the SSBs were taken on a quarterly basis over a two-year period. As indicated above, in 1977 the bottom layer of the southern portion of SSB 4 consistently produced a total solids (TS) concentration of 15 to 20 percent. Otherwise, 7 to 10 percent TS was common in all basins which had been in operation from three to four years. This is a rapid consolidation of solids in view that the digested sludge feed has averaged about 1.6 percent TS during this time.

Continued VS reduction, in combination with solids concentration, greatly affects the long-term storage capacity of SSBs. The 1975 solids study assumed that VS destruction in the SSBs would be 15 percent for the first year, gradually increasing to a maximum of 25 percent.[1] It was considered important to check these values by investigating the VS destruction that had actually occurred in the basins.

On a quarterly basis, comparisons have been made of the quantities of digested sludge added to the SSBs versus the amounts of stored sludge calculated to be present using a method which is discussed in detail in Appendix C of the SSB final report.[31] Using this procedure allows an estimate to be made of the VS destruction that has occurred in the SSBs. These estimates have routinely been made for each of the quarterly samplings conducted during the SSMP and are presented in Table 2-3. The values indicate that as much as 45 to 50 VS destruction has occurred in the first few years of storage. The general uniformity in percent VS reductions from one sampling date to the next indicates not only that the rate of VS decomposition probably decreases with time but also the maximum attainable VS reduction of digested sludge in SSBs at the Central plant is approximately 45 to 50 percent. This is considerably greater than the 25 percent anticipated in the 1975 solids study and significantly decreases the quantity of sludge which must be removed for ultimate disposal.

Table 2-3. Summary of Calculated Volatile Solids Reduction

Sampling date	Calculated VS reductions, percent
July 1, 1976	49
October 12, 1976	42
January 6, 1977	60
April 6, 1977	43
July 6, 1977	42
October 19, 1977	48
April 27, 1978	45
July 12, 1978	42

During the next three years, the District anticipates harvesting a total of 18,000 dry tons of solids; 2,000 tons in 1979, 4,000 tons in 1980, and 12,000 tons in 1981. From previous quarterly SSB solids profile data over the last two years, calculations were made to determine the amounts of stored sludge that have been available for harvesting with at least 5 percent TS concentration. The resulting quantities are given below:

Date	Accumulated sludge, dry tons
July 1, 1976	10,300
July 6, 1977	13,800
July 12, 1978	18,500

The data indicate there are sufficient quantities of stored sludge currently available of greater than 5 percent TS concentration to accommodate the anticipated harvesting schedule for the next three years without taking into account future solids loadings and concentration. From the data given above, it appears reasonable with current SSB loadings to expect an additional 4,000 to 5,000 dry tons of sludge per year of greater than 5 percent TS to be available for harvesting.

Loading and Mixer Evaluations. Using the full-size SSBs, considerable field evaluation has been completed on various modes of loading and mixer operation. Additional studies were conducted using the pilot SSBs in the SSB experimental studies discussed later in this chapter.

The SSB digested sludge design average annual loading rate of 20 lb VS/1,000 sq ft/day has proven to be a safe loading rate for the basins and one that can be used confidently during all seasons of the year. Loading rates of 40 lb VS/1,000 sq ft/day can be used for a period of two to three months during the seasonal waste loading and the summer sludge harvesting periods without basin upset.[30] Furthermore, results from the SSB experimental studies indicate that the basins can accept loading rates as high as 90 lb VS/ 1,000 sq ft/day for a period of one week during the summer without upset.[15] Daily digested sludge loading of the SSBs provides for the most efficient basin operation. Although the SSBs are designed on the basis of annual digested sludge production, they have been proven capable of accepting shock loadings of digester cleanings or excess raw waste activated sludge (WAS) for short periods of time. This capability provides a tremendous flexibility in the operations of a treatment plant. However, despite the tremendous assimilative capacity SSBs possess, the odor studies, discussed later in the chapter, have concluded that to help minimize the odor risk associated with the SSBs, time restrictions should be imposed on basin loading based on the occurrence of unfavorable micrometeorological conditions.

Mechanical surface mixers have been intensively studied during the past two years. SSBs 1 and 2 at the Central plant each have one 25-hp mechanical surface mixer, while SSBs 3 to 8 each have two units. A study in 1977 examined the necessity for mixer operation[13] and in 1978, the effectiveness of various sizes of mixers and modes of operation was evaluated.[14]

The normal mode of mixer operation has been 12 hours per day; from 6:00 a.m. to 6:00 p.m. In 1977, SSBs 5 and 6 were used in an experiment whereby both basins continued to be fed at the rate of 20 lb VS/1,000 sq ft/day, but the mixers in SSB 5 were removed from service. Failure of SSB 5 occurred in about two months and was evident by the formation of a surface film and deposits of scum and solids, hydrogen sulfide production and odor generation. Recovery of the basin occurred in approximately four days after the resumption of normal mixer operation. This study provided indisputable proof that mixers are essential components of SSB design and operation.

Questions still remained, however, regarding mixer size and minimum daily operating time. Information needed to be obtained on what horsepower of mixer and how many operating hours per day are necessary to supply the necessary minimum level of benefits for successful SSB operation. If both of these parameters are less than the existing mixers, a substantial savings in capital cost and energy usage could be realized.

The complete report for the 1978 mixer study[14] is included as Appendix B in Reference 31. Briefly, in Phase 1 of the mixer study, the effectiveness of smaller mixers on SSB operation and performance was evaluated. A 3-hp mixer used in the west pilot SSB for the source odor control study and the SSB experimental studies was operated in SSB 2 in lieu of the 25-hp mixer. Blades on the unit's mixing shaft were modified into a helical trim to determine if this design feature had any effect on equipment stress. Results from this phase of the mixer study indicated that while the helical design of the mixing blades appeared to be a desirable design feature, the 3-hp unit was inadequate for full-size SSB operation as determined by the failure of SSB 2 in about 3 1/2 months.

An intermediate-size mixer was also evaluated during Phase 1 of the mixer study. Both mixers in SSB 5 were modified to draw the current equivalent of 10 hp by removing approximately 50 percent of the blades from the large 25-hp units. The results of operating with these 10-hp intermediate-size mixers were then compared to the operation of the large, unmodified mixers in SSB 6. Operation of the intermediate-size mixers proved successful and, based on the results of the mixer study, it was recommended that two 10-hp demand units (15-hp design) be installed in all future SSBs and operated 12 hours per day. An adequate data base did not exist which would support recommending these units be operated 6 hours per day. Therefore, because of the large potential savings in energy and costs, operation of the intermediate-size mixers in SSB 5 was reduced to 6 hours per day beginning December 13, 1978, for a period of four months to see if this mode of operation would also result in successful SSB operation. Preliminary results were not definitive, however, and continued evaluation will be necessary to clearly establish the adequacy of 6 hours per day of mixer operation.

Phase 2 of the mixer study evaluated the effectiveness of reduced mixing time of the 25-hp (full-size) mixers on SSB operation. For a period of about 3 months, the full-size mixers in SSB 5 were operated 6 hours per day and compared to the 12 hours per day operation of the 25-hp mixers in SSB 6. Results from this Phase 2 of the mixer study indicated that 6 hours per day operation of full-size mixers will provide the necessary minimum level of benefits for successful SSB operation.

Design and Operational Criteria. Recommendations for design and operation of existing and future SSBs have been developed as a result of over 3 years of continuing evaluation and performance. These recommendations have been consolidated from previous SSMP reports and technical papers and modified as necessary in view of recent information developed during predesign of the Phase 1 SSBs DLD contract. The recommendations are enumerated, along with brief justifications for their inclusion, in Appendix B of this report.

Solids Storage Basin Experimental Studies

The SSB experimental studies, subtask 4.2 of the SSMP, consisted of a total of five experiments conducted during the summer of 1977. These experiments investigated various SSB operational parameters and their effect on selected basin surface layer characteristics and odor production.[15] Lasting a total of 12 weeks the experimental studies used the same pilot facilities which had been used during the source odor control study. The layout of these facilities is shown on Figure 2-3.

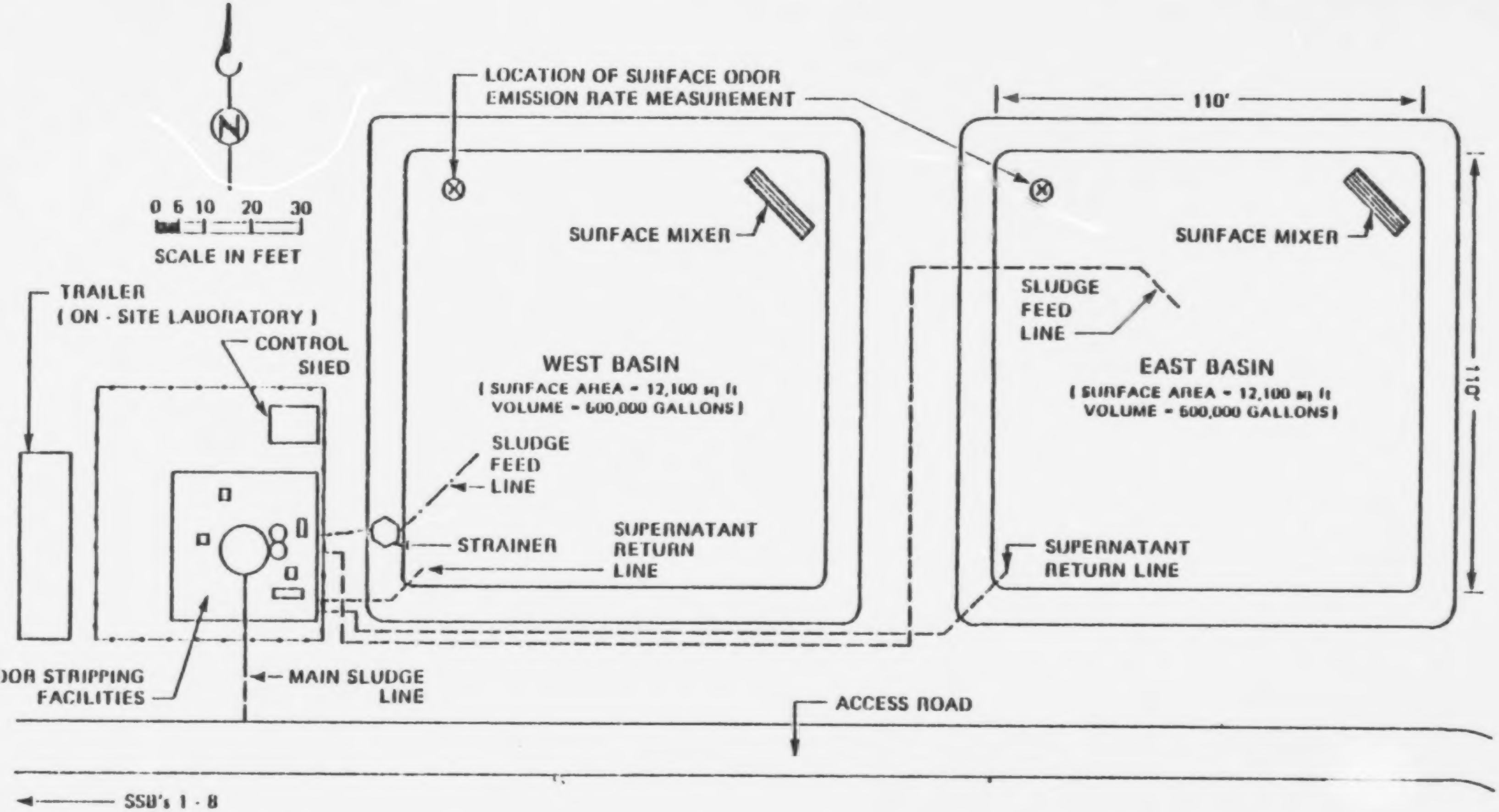


Fig. 2-3 Layout of Pilot Facilities

Experiment 1. During Experiment 1, which lasted one week, basically the same mode of operation was used on both pilot basins as during the source odor control study. That is, a loading rate of 20 lb VS/1,000 sq ft/day of digested sludge was fed to both basins, with the sludge to the west basin odor stripped by the vacuum vaporization process and the sludge to the east basin left untreated.

Some anomalies in the data occurred during Experiment 1 compared to results obtained during the previous 8-month source odor control study. Elevated surface odor emission rates (SOERs) occurred periodically not only during this experiment but in the subsequent Experiments 2 and 3 as well. A follow-up investigation clearly indicated a relationship of SOERs to digester operation and percent of raw sludge short-circuiting.[15] With complete-mix digesters as exist at the Central plant, mixing of the digester feed is never complete and there is always some undigested raw sludge which passes through the units. This amount increases as digester loadings increase and detention times decrease. Minimizing the short-circuiting percentage can best be accomplished through the addition of another new floating cover equipped digester (over and above the four currently under construction) to the Regional Plant facilities. The new digester would be operated as a storage unit and would be loaded with digested sludge from all nine complete-mix digesters. In addition to its short-circuiting benefits it would also provide an important mixing operation to dilute high odor potential sludge from some digesters with lower odor potential sludge from others since there will always be a natural variation in digested sludge from one tank to another.

Experiment 2. This experiment involved loading the west pilot SSB at 20 lb VS/1,000 sq ft/day for 5 weeks with digested sludge which had been blended with basin supernatant at a 4 to 1 ratio. Results from this experiment indicated that dilution of the digested sludge prior to feeding was not effective in reducing odor emissions from the SSB. Furthermore, it was discovered that during basin feeding, mixer operation contributed more to increased odor emissions than did the loading operation by itself.

Experiment 3. Experiment 3 was conducted concurrently with Experiment 2 and involved loading the east pilot SSB at 20 lb VS/ 1,000 sq ft/day with the feed period was from 10:00 p.m. to midnight. This experiment was to determine if loading at night, which theoretically would allow solids to settle out before daytime and provide for better light penetration, had any effect on algae and surface layer characteristics including odor production. Results from Experiment 3 indicated that by loading at night the surface layer DO concentration was able to rise to very high levels during the daytime. However, with declining supernatant DO levels in the evening, however, loading at night did result in higher surface odor emissions than were experienced from loading during the daytime.

Experiment 4. Experiment 4 was designed to load the west pilot basin to failure using digested sludge to ascertain the true loading limits of an SSB. Starting at a loading rate of 30 lb VS/ 1,000 sq ft/day, the west pilot basin loading was increased until the basin was receiving 110 lb VS/1,000 sq ft/day be the sixth week or five and one-half times the design loading rate. At this time failure was declared due to unacceptable odor emissions. It was concluded that an SSB can be loaded at 90 lb VS/1,000 sq ft/day for a period of one week without upset. The results also showed the algae population to be unaffected by this extremely high loading rate. Maintenance of a stable algae population allowed the basin to recover quickly once the heavy loading ceased.

Experiment 5. This experiment was conducted concurrently with Experiment 4 and was designed to load the east basin to failure but using raw WAS. Based on unacceptable odor emissions, failure in this experiment was achieved after only one week using a WAS loading rate of 10 lb VS/1,000 sq ft/day. The amount of raw WAS that can be successfully added to a basin, however, is not believed to be related to this loading rate because previous emergency loadings of the existing full-size SSBs were at considerably higher rates and did not result in high odor levels. It is believed, however, that the amount of raw WAS that can be successfully added to a basin is related to the basin's buffering capacity, a characteristic which is dependent on the amount of stabilized solids a basin contains. This buffering capacity for the pilot basin was exceeded by the sixth day of the first week, hence the apparent failure at the low loading rate of 10 lb VS/1000 sq ft/day. Subsequent loadings of raw WAS increasing in the fifth week of this experiment to a rate of 50 lb VS/1,000 sq ft/day, did not have a detrimental effect on the algae. The basin recovered approximately 2 weeks following the completion of the fifth week of the experiment.

Recommendations. The following recommendations resulted from the SSB experimental studies:

1. Vacuum vaporization should be used to strip high volatility odor from digested sludge, thereby minimizing odor release from sludge feed.

2. Surface mixers should not be operated during or immediately after basin feeding.

3. Digested sludge feed is assimilated far better when discharged during daylight morning hours. Nighttime discharge should be avoided.

4. No advantage results from diluting digested sludge with basin supernatant up to a 4:1 ratio prior to feeding.

5. Odor (surface odor emissions) is the best criterion for determining SSB failure. DO and sulfide levels are the next best indicators.

6. Shock loadings, such as digester cleanings or excess WAS, should be distributed to SSBs in relation to the quantity of buffer (stabilized solids) they possess.

Groundwater Monitoring and Site Engineering Work

Work in this subtask (4.3) was directed at investigating the potential for groundwater degradation resulting from implementation of the SSB-DLD solids processing and disposal alternative. This subtask has consisted of a regular monitoring program and detailed field studies. Also included in this subtask was a site planning and soils investigation study of the area proposed for development of the recommended project. A geotechnical study for a future DLD site, although conducted under this subtask, will be discussed in a following section on the DLD study.

Monitoring Program. In 1974 and 1975, just prior to the beginning of the SSMP, eight shallow groundwater monitoring wells were installed around the periphery of the eight existing SSBs (Figure 2-1) and drilled to a depth of 15 to 20 ft below the bottom of the basins. Since their installation, the wells have been continuously monitored on a monthly basis to obtain valuable background data and to detect any subsurface leakage of SSB contents that might occur. Groundwater monitoring data have been summarized in previous SSB reports.[29,30,31] Although not uniform, the monitoring results from these SSB test wells have conclusively indicated that there has been no leakage from the basins.

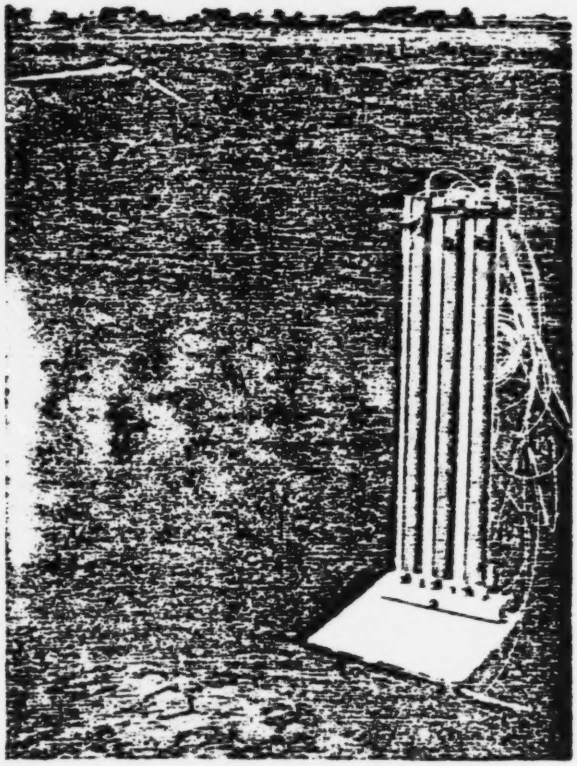
Study of Sludge Pond Permeability. While monthly monitoring of the SSB groundwater continued, a special study was undertaken during the latter part of 1975 utilizing one of the two small 0.25-acre pilot SSBs to investigate the movement and character of soil water beneath the pilot basins.[16]

Tensionmeter instruments, which can be used to measure soil moisture tension and act as suction devices to extract soil solution samples for chemical analysis, were installed at varying depths below the bottom of the 6-ft deep pilot basin prior to the basin being filled with harvested sludge. Then, for a period of almost 4 months, soil moisture readings were taken and, at the end of this time, soil solution samples were obtained prior to final evaluation of the data.

The report's conclusions confirmed the findings of the SSB groundwater well monitoring indicating there had been no contamination of groundwater as a result of storing sludge in the basins. Evaluation of the data revealed that after two weeks, the liquid contents of the pilot basin had percolated to a depth of 60 cm, but had not penetrated any further. Containment of the liquid percolate to a shallow depth below the pilot SSB was attributed to the self-sealing action of the soils at the bottom of the basin.

SSB Bottom Permeability Study. Subsequent to the completion of the pilot SSB permeability study additional, more detailed investigative work on the bottom permeability of the full-size SSBs was initiated.[17] This SSB bottom permeability study consisted of two parts, with Part 1 investigating the permeability of SSBs 5 and 6 and Part 2 involving the taking of undisturbed soil samples from the bottoms of SSBs 2 and 6. In June of 1976, two nests of tensiometers were installed at varying depths below the bottoms of SSBs 5 and 6 prior to their initial filling with plant effluent. Soil moisture data were obtained from October of 1976 through January 1977. As with the pilot SSB permeability study, soil solution samples were extracted at the end of the experimental period and analyzed for major ions, specific conductance and pH.

Part 2 of the permeability study was conducted at the request of the District after a recent paper was discovered in the literature which documented heavy metal migration beneath two



Mercury manometers located on the berm of a pilot SSB. This apparatus was used with tensiometers installed beneath the basin to measure soil moisture tension and extract soil solution samples for analysis.

sewage sludge lagoons. In August of 1977, undisturbed 15-ft soil cores were extracted from the bottoms of SSBs 2 and 6 and analyzed for selected heavy metals and COD. SSB 2 had been continuously loaded with sludge since July, 1973, and was selected because it had been in service for the longest time. SSB 6 had been loaded since August, 1976, and was selected so that cores could be extracted adjacent to the tensiometer nests.

Analysis of the tensiometer data, soil solutions, saturation extracts, heavy metal analyses and the saturated permeability analyses showed that the SSBs seal themselves and pose no threat to groundwater. The data indicated that SSB 6, with a sandy bottom and a low sludge loading rate, apparently took longer to seal than SSB 2 which was heavily loaded with sludge and has a sandy, silty clay bottom. However, after 2 to 3 months both basins had sealed. It was postulated that a combination of mechanical sealing of soil pores from the sludge and the production of mucus-like materials by microorganisms in the soil and sludge form an impermeable membrane between the stored sludge and the underlying soil.

Site Engineering Study. This work was initiated prior to certification of the SSMP EIR because at least eight additional SSBs were required regardless of the alternative selected. It was imperative that design work proceed immediately to have sludge processing facilities on-line when the Regional Plant begins operation in 1980. Since grant eligibility of design work at this early date was questionable, the District authorized detail design work on only 8 of the 12 SSBs of the recommended project and only one DLD site. Two site geotechnical studies[18,18a] and an advanced site planning report,[86] have been completed. Detail design on the remaining four SSBs, the remainder of the DLD sites, the ash, grit, scum and screenings landfill site, the flood control levee, and the vacuum vaporization, sludge storage and blending facilities were not to start until a formal decision on the project had been made. A more detailed discussion of the design and construction of these facilities is presented in Chapter 3.

The objective of this advanced site planning report[18b] was to examine alternative SSB-DLD site layouts, alternative ash, grit, scum and screenings disposal systems and alternative flood control levee locations. The various alternatives and systems were evaluated based on relative capital costs, environmental factors, operation and maintenance considerations, and compatibility and flexibility considerations.

Odors and groundwater were important environmental considerations. Results from the odor studies indicated that the location of the SSBs in relation to the prevailing winds, other SSBs, and the proximity to the plant boundary influence downwind odors. Site engineering studies showed there to be deeper soils in the eastern portion of the proposed area of expansion. Therefore, to minimize any threat of groundwater degradation, it was concluded that future DLD sites should be located in the area of deeper soils and the additional SSBs could be located in the extreme western portion of the area where the impervious soils are not as well developed; SSBs in this location would be more acceptable in view of their self-sealing action as discussed above.

The engineering and environmental evaluation of alternative site layouts resulted in a recommended alternative for each of three site development categories listed above. The recommended site development plan was shown on Figure 2-1.

Diurnal Odor Evaluations

The diurnal odor evaluations (subtask 4.4 of the SSMP) consisted of a total of eight diurnal odor studies which were conducted at the SSBs from the fall of 1974 through the end of 1975.[19] Each diurnal odor study consisted of 24-hour, around-the-clock monitoring of an SSB for surface odor emissions and downwind odor concentrations. Other information obtained during the studies included climatological data such as wind velocity and direction, air and surface liquid temperatures, pH of the SSB supernatant and pertinent information on sludge loading and aerator operation.

The specific objectives of this series of odor studies were to identify: (1) the maximum odor conditions and the probable cause of these conditions, and (2) those conditions which were likely to result in odor complaints and to recommend steps to be taken to reduce the likelihood of such occurrences.

As a consequence of these studies, it was determined that odor problem conditions would likely result when the following three conditions occur simultaneously:

1. High surface odor emissions.

2. Calm to stable climatological conditions in which the "puff" odor transport phenomenon (a sudden irregular gust of odor) prevails.

3. People are awake with windows open or are involved in outdoor activities.

Of the conditions leading to maximum surface odor emissions at the controlled SSBs (those loaded at or below 20 lb VS/1,000 sq ft/day), the report concluded that volatile components associated with the digested sludge were primarily responsible for maximum odor emissions. In conjunction with certain climatological conditions, human activities, and surface area of controlled SSBs, these maximum surface odor emissions might result in significant downwind odors which would prompt odor complaints. The probable factors affecting the source odor emissions and downwind odors are sludge characteristics, SSB environment, operational variables and climatological conditions. Some of these factors can be controlled to some extent such as sludge characteristics, SSB environment, and operational variables; however, climatological conditions cannot be controlled.

It should be noted that no odor complaints occurred during any one of the six diurnal studies conducted in 1975, and except for two of the studies, downwind odors were, in fact, not detectable regardless of surface odor emissions. Furthermore, only one of the eight odor complaints which occurred in the vicinity of the Central plant in 1975 seemed to be associated with the odors from uncontrolled SSBs 3 and 4.

To reduce the likelihood of odor complaints due to the operation of SSBs when planned residential development around the site has occurred, the study recommended implementing the following four programs.

1. Evaluating alternative processes for controlling source odor emissions.
2. Evaluating effects of varying SSB operational modes.
3. Continuing odor complaint evaluation and climatological data reduction.
4. Evaluating the effect of large-scale odor emissions on downwind odors and developing an odor criteria.

Source Odor Control Study

The SSB source odor control study (subtask 4.5 of the SSMP) was undertaken to investigate the feasibility of removing odorants from digested sludge prior to its introduction into the SSBs.[20] This study was composed of bench-scale as well as field experiments and was conducted between April, 1976 and July, 1977. The primary objectives of this study were to determine if odors could be effectively and permanently removed from the digested sludge prior to its being fed to the SSBs and to determine an effective means of controlling any point source odors resulting from the removal of these odors.

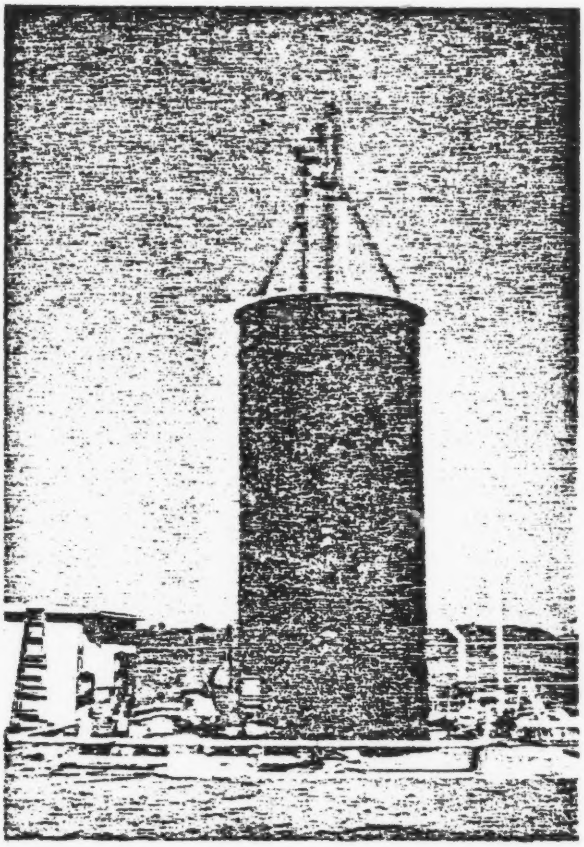
Phase 1 of this study consisted of the design, fabrication, construction, and start-up of the pilot odor control facilities. The layout of these facilities was shown on Figure 2-3. Two pilot SSBs, each having a surface area of approximately 12,100 sq ft and an operating depth of 5 ft, were constructed as part of these facilities.

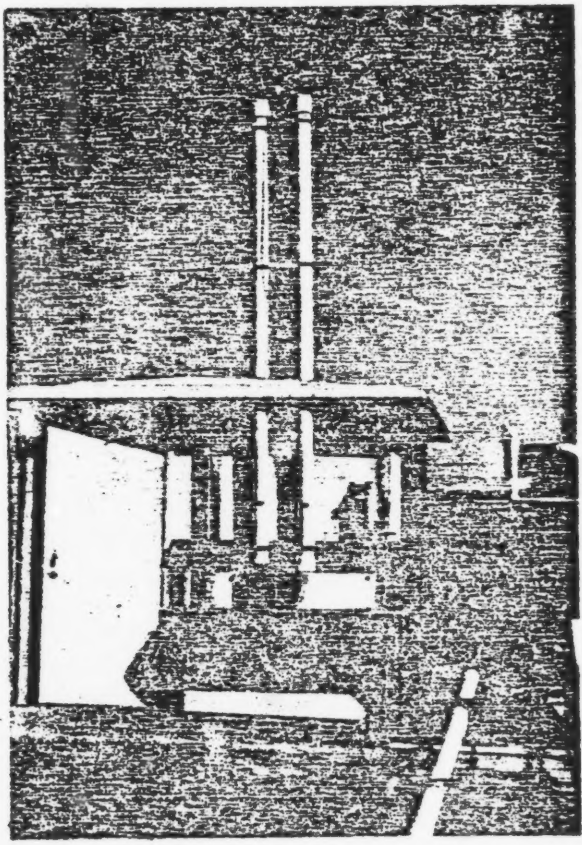
During Phase 2, two processes for digested sludge odorant removal, air stripping and vacuum vaporization, were evaluated for their effectiveness in removing odors from digested sludge. This evaluation was based on performance and energy efficiency. Vacuum vaporization, a process whereby the more volatile liquid of the digested sludge is vaporized as a result of creating a vacuum environment, was determined to be the preferred method of odor stripping primarily because of higher energy efficiency and lower off-gas flow rates which required subsequent deodorization.

Phase 3 of the study consisted of an evaluation of alternative methods of off-gas odorant control. The three processes investigated were activated carbon adsorption, reactive chemical scrubbing, and water scrubbing. Activated carbon adsorption was selected as the recommended method of off-gas odorant control of the vacuum vaporization process. Using carbon adsorption, greater than 90 percent removal of the off-gas odors was achieved with the final odor concentration generally below 50 ou, an odor level which meets the point source odor criteria established for the Regional Plant.

Phase 4 of the SSB source odor control study involved a long-term evaluation, comparing a pilot-scale SSBs, one loaded with digested sludge and the other with vacuum-vaporized odor-stripped digested sludge. Both pilot basins were loaded on the controlled basis (20 lb VS/1,000 sq ft/day). The objective of this evaluation was to determine if an initial reduction in odorant concentration would result in the long-term reduction or mitigation of odors

Pilot odor control facilities during initial construction. Shown here are the large sludge storage tanks, piping, pumps and the control shed to the left of the tank.





Bench-scale facilities used to evaluate alternate methods of off-gas odorant control. Methods evaluated included activated carbon adsorption, reactive chemical scrubbing and water scrubbing.

from the surface of SSBs. The observed effect of the vacuum vaporization process was to reduce SSB surface odor emissions both before and during sludge loading. Summary data for March through June 1977 is presented in Table 2-4. This data indicates an average of approximately 50 percent reduction in surface odor emissions was obtained both before and during loading when measured away from the edge of the basins. Results obtained at the basin edge showed a 46 percent reduction before sludge loading and a 60 percent during loading. For data taken away from the SSB edge before loading, the mean emission rate was reduced from 4.2 to 2.08 ou/min-sq ft and during loading the emission rate was reduced from 5.94 to 2.99 ou/min-sq ft. In all months where substantial data were taken, the reductions in surface odor emissions between the SSB receiving stripped digested sludge and the SSB receiving unstripped digested sludge ranged from 47 to 64 percent.

The source odor control study recommended the implementation of the following programs:

1. A single-stage vacuum vaporization digested sludge odorant removal system to strip odors from digested sludge prior to pumping into an SSB. The system should be designed using criteria developed in the pilot investigation. It is recommended that the system be operated continuously prior to any introduction of digested sludge into an SSB.

2. An activated carbon adsorption off-gass odorant control system to reduce off-gas odors from the digested sludge odorant removal process to a level meeting specified odor criteria. The design criteria developed in the pilot investigation should be used in the design of this system.

3. A program should be developed coordinating sludge digestion, vacuum vaporization and SSB loading to minimize the emission of odors from SSBs. Sludge feed to the

Table 2-4. Monthly Comparison of Pilot SSB Surface Odor Emissions During the Source Study

Parameter[a]	3/77		4/77		5/77		6/77		3/77-6/77 averages	
	Experimental[b]	Control[c]	Experimental	Control	Experimental	Control	Experimental	Control	Experimental	Control
Before loading-edge										
Mean emission rate	2.73	3.75	2.3	4.9	1.58	3.11	-	-	2.11	3.95
Standard deviation	1.3	2.0	1.8	5.3	0.55	2.47	-	-	1.4	3.81
Percent reduction	27[d]	-	53	-	49	-	-	-	46	
Before loading-center										
Mean emission rate	-	-	2.0	2.7	1.57	3.58	2.8	5.6	2.08	4.2
Standard deviation	-	-	1.0	1.2	0.42	2.55	1.7	3.7	1.3	3.68
Percent reduction	-	-	26[e]		56		50		50	
During loading-edge										
Mean emission rate	4.71	13.1	2.8	5.3	1.59	4.21	-	-	3.11	7.8
Standard deviation	3.1	9.9	2.03	3.6	0.52	2.55	-	-	2.5	7.5
Percent reduction	64		47		62		-	-	60	
During loading-center										
Mean emission rate	-	-	3.11	4.2	2.09	4.79	3.83	7.6	2.99	5.94
Standard deviation	-	-	1.9	2.6	1.75	2.56	2.1	4.9	2.05	3.95
Percent reduction	-	-	26[e]		56		50		50	

[a] Results reported in ou/min-ft^2 unless otherwise noted.

[b] Basin was fed odor stripped digested sludge.

[c] Basin was fed untreated digested sludge.

[d] Ten data points only.

[e] Six data points only.

> digesters and withdrawal should be carefully controlled to ensure the discharge of only well-digested sludge. The vacuum vaporization process should be operated continuously while loading the SSBs to reduce surface odor emissions, both during and after loading. The feeding of SSBs should be carefully controlled to prevent overloading. Feeding and surface mixer operation should not coincide and should only take place during periods of favorable micrometeorological conditions and minimal outdoor activity.

Development of Large Area Emission Odor Criteria

Point source odor emission standards were initially developed for the Regional Plant in 1974 but were found to be unrealistic when applied to the large emission areas of the SSBs; therefore, the District undertook a second study to develop better odor criteria for large emission areas.[22] This large area emission study was subtask 4.6 of the SSMP and was conducted concurrent with the SSB source odor control study. The emission area study produced a mathematical model for odor transport under the worst meteorological conditions, an estimate of odor risk for the SSBs, and a preliminary evaluation of several mitigating measures to reduce odor risk.

Initial work on the large area emissions study indicated sufficient odor risk could be associated with the SSBs to seriously jeopardize their acceptability for incorporation into the Regional Plant's solids processing system. However, the extension of the SSB odor studies through 1978 provided the needed time to conduct additional field studies. During 1978, more conclusive micrometeorological monitoring data was obtained, full-scale field evaluations of odor control measures were conducted and studies were completed on the interaction effect of odor generated from emergency storage basin (ESB) operation on the overall large area emission odor risk associated with the SSBs for the Regional Plant.

Large Area Emissions Study. One task of the initial large area emission study was to define the relevant measures for correlating emissions from the SSBs with downwind odor concentrations. For a point odor source, two measurements are required: (1) the source odor emission rate and (2) the downwind odor concentration. For a large emission area, three measurements were identified: (1) the odor emission rate per unit of surface area, (2) the downwind edge odor concentration, and (3) the downwind boundary odor concentration (usually taken at the Regional Plant boundary line). A relationship between the first two measurements was developed to allow the larger area of the future SSBs to be approximated by an equivalent point source.

The meteorological conditions which would most likely cause high downwind odor concentrations had to be defined. Stable wind conditions and calm conditions were studied; the calm conditions associated with strong inversions were found to produce measurable odors most frequently. The worst conditions were those which resulted in a "puff" transport of the odors. These worst conditions were defined in terms of lateral dispersion (the rate of change of wind direction) and temperature gradient (the rate of temperature change with altitude).

A mathematical model was developed to correlate SSB surface odor emission rates and downwind odor concentrations for the worst meteorological conditions. Using known emission rates and meteorological conditions, downwind odor concentrations were computed with the model. However, both meteorological conditions and emission rates were found to be highly variable and were best expressed by curves representing the probability of given values. The original objective of the study was to produce maximum acceptable values for surface emission rates. However, the high variability in emission rates and meteorological conditions made this type of operating criteria unrealistic.

To better describe the odor risk of the SSBs, the transport model and the probability curves for emission rates and meteorological conditions were used to compute the probability of exceeding odor objectives at the property line. The probability of an odor occurrence was expressed as the most probable number of days per year in which odors might exceed the 2 ou/cu ft objective, 5 ou/cu ft (threshold complaint level) or 10 ou/cu ft (complaint level) at the plant boundary. This exercise was completed in this initial study for the existing 40 acres of SSBs and for the proposed SSBs totaling 120 acres; the results are presented in Tables 2-5 and 2-6.

The primary significance of the values shown in the table are their relative magnitudes, not the absolute numbers. For example, comparing the tables, the effect of tripling the surface area of the SSBs is to double the odor risk, assuming only operational control. Wind machines and barriers reduce the risk of all odor levels by more than 50 percent; the further addition of odor stripping reduces the risk to about one percent of that without controls.

This initial study defined the important meteorological factors which determine odor transport. These factors can be measured to determine when adverse conditions for odor transport are present. Mitigation measures could be used during these critical times to reduce odor risk. Two mitigation measures were given limited tests in this initial study for their effectiveness in reducing downwind odor concentrations. Both measures have been used in agriculture, although not specifically for odor control. One measure, barriers around the SSBs, would increase the initial dispersion of odors at all times when there was any wind. The other measure, wind machines, would be used to increase the initial dispersion only during calm meteorological conditions. The combination of wind machines and barriers was estimated in this initial study to reduce the probable number of days exceeding the odor criteria by one-half.

Table 2-5. Estimated Odor Risk for Existing SSBs

Odor control method		Probable number of day/yr[a]		
Source control	Dispersion	2 ou/ft^3	5 ou/ft^3	10 ou/ft^3
Operational	None	49	24	13
Operational plus odor-stripping	None	10	1	0.2
Operational	Wind machines and barriers	15	7	4
Operational plus odor-stripping	Wind machines and barriers	0.5	<0.2	<0.2

[a] Number of days on which the given odor concentration will be reached or exceeded for one hour or more at the plant boundary (2,000 ft downwind).

Table 2-6. Estimated Odor Risk for Proposed SSBs

Odor control method		Probable number of day/yr[a]		
Source control	Dispersion	2 ou/ft^3	5 ou/ft^3	10 ou/ft^3
Operational	None	94	55	33
Operational plus odor-stripping	None	45	13	4
Operational	Wind machines and barriers	38	18	10
Operational plus odor-stripping	Wind machines and barriers	6	0.7	0.2

[a] Number of days on which the given odor concentration will be reached or exceeded for one hour or more at the plant boundary (2,000 ft downwind).

This initial, large-area emission study identified areas requiring further study. Estimates of odor risk for the 40 acres of SSBs in operation in 1977 indicated that complaint-level odor concentrations should have occurred on several occasions. No odor complaints were received during this time period; and thus, the model appeared to predict too high an odor risk. However, the sparsely populated area does not provide assurance of this. Additional studies were authorized in 1978 to further refine the predicting model and to obtain more accurate estimates of the frequency of adverse meteorological conditions.

In addition to the operational measures recommended by the source odor control study, the initial large area emission study recommended:

1. Wind machines and barriers be installed at the SSBs to enable the plant operators to create artificial initial dispersion conditions during adverse meteorological conditions.

2. Automatic atmospheric monitoring equipment be installed at the SSBs to provide the plant operators the necessary data to accurately define adverse meteorological conditions.

Odor Interaction of ESB and SSB Systems. The downwind odor risk potential for the Regional Plant is, to a large extent, dependent on odors emitted from large area sources. While the SSBs constitute one large area source, the ESBs, which are used for the storage of plant effluent during periods of low flow in Sacramento River, constitute a second potential large area odor source having an 80-acre surface area when full. Previous studies evaluated the two major large area sources and their effect on odor risk when considered separately.[22,23] If the odors from the two sources were additive or synergistic, then both sources would have to be considered in a risk analysis. Conversely, if the odors were antagonistic, then the sources may not need to be considered in combination.

The objective of the study of odor interaction of ESB and SSB systems was to evaluate quantitatively, the interactions of odor emissions from the SSB and ESB surfaces[25]. Knowledge of the general way in which odors from the two sources interact would provide an objective means of determining the need for the inclusion of both systems in odor risk evaluations.

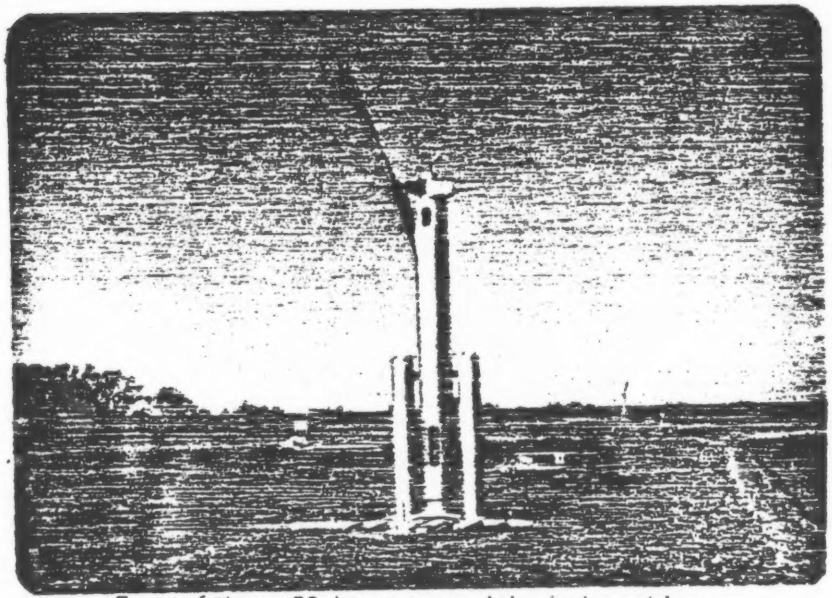
Results from the study indicated no significant odor antagonism (cancelling effect) or synergy (multiplying effect) occurs between the ESB and SSB systems. The report recommended that the odors from both systems be treated as directly additive and, therefore, the effects of both systems must be considered in combination when determining the odor risk of the Regional Plant. Such was the case in the final report on the assessment of odor risk discussed below.

Assessment and Control of Large Area Odor Emissions. In February of 1979, the final report on assessment and control of large area odor emissions was submitted.[27] This report summarized the odor work which was conducted during 1978, including the ESB study discussed above, and presented a revised odor risk assessment of the proposed SSB-ESB system. Additional reports were prepared in 1978 which covered specific phases of the odor work. These reports included:

- Preliminary Reassessment of Odor Risk[23]
- Development of Design Criteria for Wind Machines and Barriers[24]
- Effectiveness of Barriers and Wind Machines for Control of Large Area Odor Emissions[26]

The objective of the preliminary reassessment of odor risk was to provide an updated assessment of odor risk from that presented in the large area emission study based, in part, on micrometeorological monitoring that had been completed during the

Approximately 6,000 ft of this 12-ft-high barrier was constructed around the SSBs for full-scale field testing for effectiveness in providing odor dispersion.



Four of these 75-hp commercial wind machines, designed for frost protection in vineyards and orchards, were installed within the barrier system and evaluated for effectiveness in providing odor dispersion.

first four months of 1978. During that same period of time, design criteria for wind machines and barriers were being developed, through a literature search and wind tunnel simulation, to determine how they could best be used to increase initial dispersion of odors, preparatory to a full-scale evaluation in the fall. The 1978 odor studies culminated in the fall, following the construction of a 12-ft high barrier around the existing SSBs and acquisition of the necessary wind machines, with full-scale field testing of their effectiveness in providing odor dispersion.

The final odor risk assessment was based upon the following:

1. Micrometeorological monitoring during the calendar year 1978.
2. Monitoring of SSB and ESB source odor emission rates during the summer of 1978.
3. Measurement of the atmospheric diffusivity with and without barriers during the summer and fall of 1978.
4. Measurement and verification of the additivity of SSB and ESB odors.
5. Measurement of the effectiveness of odor stripping (vacuum vaporization) on SSB surface odor emission rates as determined during the first half of 1977.

Table 2-7 presents the final estimated odor risk for the proposed SSB-ESB system. For comparison, the odor risk assessment for the proposed SSBs, previously presented in Table 2-6 of this chapter, is also included in the table. The 1978 odor studies have provided valuable data which have been used to more accurately redefine the large area emission odor risk to the very low level represented in Table 2-7. The final odor risk assessment includes the odor risk associated with the ESB, and is based on the use of

Table 2-7. Final Estimated Large Area Odor Risk

Source of data	Probable number of days/yr[a]		
	2 ou/ft^3	5 ou/ft^3	10 ou/ft^3
Preliminary assessment of odor risk[b]	6	0.7	0.2
Final report on assessment of odor risk[c]	3.3	0.5	<0.1

[a] Number of days on which given concentration is reached for one hour or more at plant boundary.

[b] Source: Reference 23. Data was presented in Table 3-3 of this report and is based on the utilization of all odor controls except digester control.

[c] Source: Reference 27. Odor risk includes combined effect of SSBs and ESB and all odor controls including digester control.

all odor controls (mitigation measures) including digester control. On January 22, 1979 this data was formally presented to the Regional District's Board of Directors at the hearing on the SSMP final EIR. Certification of the final EIR and adoption of the recommended project by the Board indicates the SSBs (and ESB) do constitute an acceptable odor risk.

Feasibility of Covering the SSBs

The feasibility of covering the SSBs, subtask 4.7 of the SSMP, was completed prior to most of the detailed odor investigations of the last three years.[28] This topic was of interest to the District, both as to (1) design parameters and costs of covering all SSBs in the event odor concerns could not be resolved otherwise, and (2) the possibility of covering at least one SSB to accept emergency dumps of "sour" sludge from a malfunctioning digester. Air-supported covers appeared particularly promising in that they had a clear span, seemed easily adapted to the plan form of the existing and contemplated SSBs, and were thought to be potentially of low cost.

While the study had, as its primary objective, the determination of the feasibility of covering at least one existing SSB with an air-supported structure to accommodate emergency dumps, consideration of other types of covers was also within the study's scope, as well as consideration of covering all SSBs as mentioned above.

The study explored five alternative covers, including air-supported, liquid-supported and tension membrane cover systems, and built-up roof and corrugated aluminum roof systems. Both long-span and short-span, air-supported cover system was found to be the most expensive alternative and also proved to be impractical because it would involve a large amount of ventilation air leakage. This leakage, which would be impossible to collect, made it impossible to guarantee odor containment or removal. The floating cover system was found to be economically favorable, but completely unacceptable because of the danger of entrapped gases causing uncontrolled bubbles which would result in cover failure during windy periods. With the elimination of flexible covers, the final cost-effective selection was limited to the two rigidly supported roof systems. Cost differences between these alternatives clearly indicated that the build-up roof system was the most cost-effective alternative.

The study indicated the infeasibility, based on the state of the art, of using flexible cover systems for any of the SSBs, and did provide valuable information which would allow for the immediate final design of a rigid roof system to be developed immediately if it became necessary to do so. However, it was considered to be premature to commit any of the SSBs to be covered prior to the completion of the SSMP studies in view of the fact that actual experience with the wasting of undigested WAS to those basins had shown them to possess a tremendous buffering capacity. Future experimentation was expected to indicate whether or not this buffering capacity would also be capable of assimilating the solids from an upset or "sour" digester. In light of the results of the experimental tests of subtask 4.2, it is believed such covering will be unnecessary as long as the contents of such "sour" digesters are distributed to SSBs in relation to the quantity of buffer (stabilized solids) they possess.

DEDICATED LAND DISPOSAL STUDY

The DLD study has been another major component of the SSMP over the past three years. Originally, as discussed in Chapter 1, the intent of the SSMP was to evaluate agricultural reuse of sludge as proposed in the 1975 study on wastewater solids processing and disposal.[1] However, because of various constraints, the District staff recommended that the disposal aspect of the SSMP be redirected to evaluate application of liquid, stabilized sludge to land dedicated in perpetuity for such use.

The location of the 20-acre DLD experimental area in relation to the existing SSBs and the Regional Plant site was shown on Figure 2-1. DLD utilizes sludge application rates 20 to 30 times greater than that associated with an agricultural system and, because of this, the land area requirement and distribution system are reduced and simplified. With DLD, scheduling around farming operations is not necessary which has the effect of lengthening the spreading season. Furthermore, the DLD system is owned by the District, allowing tighter controls over the monitoring and disposal operation.

The DLD study was composed of three subtasks as shown on Figure 1-3. Two annual reports,[32,33] a final report[35] and several special studies[34,36,37] have been completed. This DLD study has been directed towards the evaluation of alternate methods of sludge spreading and soil incorporation from an engineering, economical and environmental basis, and the development of precise design and operational criteria for the recommended system.

Environmental Concerns

Because of excessive sludge application rates with the DLD method of sludge disposal, potential groundwater degradation is the major environmental concern. Other concerns, such as odor production and surface water degradation, are not as severe because they can easily be controlled through proper system design and operation. Table 2-8 summarizes the DLD monitoring program which is discussed more thoroughly below.

Groundwater. A rigorous monitoring program has been directed at determining the fate of sludge chemical constituents at the DLD site and the potential for groundwater degradation. Soil, soil

Table 2-8. Experimental DLD Site Monitoring Program

Sample medium	Monitoring program	
	Number of samples each year	Constituents
Soil	48	pH, NO_3, PO_4, SO_4, HCO_3 + CO_3, Cl, Ca, Mg, Na, K, B
	12	Cd, Cu, Ni, Zn (DTPA); chlorinated hydrocarbons, PCBs CEC, TKN, NH_4, TOC
Soil solution	128	pH, NO_3, PO_4, SO_4, HCO_3 + CO_3, Cl, Ca, Mg, Na, K, B
	12	Chlorinated hydrocarbons, PCBs, Zn Cd
Groundwater	24	pH, NO_3, PO_4, SO_4, HCO_3 + CO_3, Cl, Ca, Mg, Na, K, B, Zn, Cd
	6	Chlorinated hydrocarbons, PCBs
Surface runoff	12	pH, EC, turbidity, NO_3, Cd, Cu, Ni, Zn, Pb, Hg, TKN, NH_4, T. Coli, F. Strep, F. Coli, chlorinated hydrocarbons, PCBs

solution and groundwater samples have been taken on a regular basis and a series of site-specific studies have been completed.

Soil samples from twelve locations and four depths in the DLD site have been taken primarily to determine the fate of immobile sludge chemical constituents such as heavy metals, chlorinated hydrocarbons and PCBs. Six soil solution sampling sites have been monitored at the DLD site after each major rainfall. For the evaluation of potential groundwater degradation due to major ions such as sodium, chloride, sulfate, boron, etc., soil solutions are superior to other sampling techniques. From good soil solution data, it can be determined what is happening to the percolating water and what the effects will be. Groundwater samples have been taken from twelve monitoring wells, four within and eight outside the DLD site boundaries. The main value of groundwater monitoring has been to furnish benchmark information which will make possible long-range comparisons to be made with future data.

The soils of the DLD site have been examined from morphological and engineering standpoints. Soil profiles were studied by Mr. Eugene Begg, a University of California at Davis agricultural soils expert, in 1976 and he found that the site contained both Freeport and San Joaquin soil series which, he concluded, impede or prevent any deep percolation of applied water into the groundwater.[36] Lowry and Associates, local geotechnical consultants, conducted permeability tests on undisturbed soil cores from the experimental DLD site in 1977 and found that the permeability rates ranged from 2.8×10^{-8} to 3.7×10^{-10} cm/sec, with rates less than 10^{-7} cm/sec regarded as practically impermeable.[37] Both of these soil studies, therefore, have indicated that sludge disposal at the DLD site would not pose a threat to local groundwater. A 1978 soils study by Lowry and Associates for the proposed Phase 1 DLD facilities (Figure 2-1) found permeability rates of the uppermost surface soils ranging from 2×10^{5} for the find sandy salt soils, generally distributed over the elevated portions of the site to 1 x 10^{-10} cm/sec for the highly plastic organic clays, present in the lowlands of the area. Although the sandy silts displayed relatively high coefficients of permeability, these materials were discovered only in thin layers. It was concluded that the aggregate permeability rate for the composite layered interval over higher terrain probably is less than 5 x 10^{-8} cm/sec.[18] The study concluded, therefore, that the proposed DLD sites have a relatively consistent areal distribution of impermeable subsurface, near surface and deeper cemented soils.

Odors. Quantitative odor measurements were taken of the spreading experiments conducted in 1976, 1977 and 1978. The subsurface injection studies in 1976 and 1978 produced minimal or no odors during injection but some slight odors were detected when the soil was subsequently disked to promote drying. The 1977 surface spreading studies did produce some significant odors. This was the result of sludge applications 4 to 6 in. thick which saturated the soils and resulted in the production of anaerobic conditons. For this reason, it was concluded that surface spreading by gravity flow was an unacceptable disposal method. A mechanical, surface spreading method was evaluated in 1978 along with the subsurface injection system. This method, which assures the distribution of a thin layer of harvested SSB sludge uniformly over half the DLD site, produced no significant odor emissions.

Surface Water. Potential surface water degradation as a result of DLD operations is an environmental concern which has been and will continue to be alleviated through the use of proper engineering design. A flood control and runoff containment levee was constructed around the existing experimental DLD site to preclude surface runoff from contaminating Morrison Creek. Runoff has been conveyed to a collection sump at the northeast corner of the DLD site and pumped back as necessary to the Central plant for treatment prior to discharge to the Sacramento River. A similar system will be applied to all future DLD sites. For Phase 1 and 2 SSB and DLD development (Figure 2-1), a flood control levee will be constructed along the periphery of the entire site for protection of surface waters; runoff from the ash landfill and DLD site, and excess supernatant from the SSBs will be returned to the Regional Plant for treatment through a common return system.

Evaluation of Alternate Methods of Sludge Application

The two major categories of sludge application include subsurface injection and surface spreading. During the past three years of the SSMP, subsurface injection and five variations of surface spreading have been evaluated. A review of the information obtained is given below.

Ridge and Furrow. The feasibility of this method of sludge application was detemined in the fall of 1975, followed by a more extensive evaluation in 1977. With this method, sludge was allowed to flow down furrows and then covered by splitting the ridges.

Several attempts were made to perfect the ridge and furrow method, but all were unsuccessful for the following reasons:[32]

1. Covering worked reasonably well in the 1975 test because the soil was finely powdered and friable. In the 1977 test, however, the soil had become puddled and cloddy due to its having been worked in a wet condition. This cloddy, puddled soil did not cover the sludge nearly as well as the friable, finely dispersed soil in 1975.

2. It was very difficult to maintain sufficient loose dirt to allow for deep furrows and sludge coverage. The soil had a tendency to "set up" immediately below the plow sole and become unmanageable. The furrowing equipment repeatedly gouged into the sticky plastic subsoil and was thrown out of alignment.

3. Quite aside from the gouging problem, keeping the furrowing equipment in proper alignment proved to be an overwhelmingly difficult task.

4. Insufficient slope caused the furrows to be filled so full that covering was not practical.

5. The plugging of the gates in the gated pipe constantly frustrated attempts to introduce an even flow of sludge to the furrows.

After numerous attempts to improve the system, it was concluded that the problems associated with it were too formidable and the method was abandoned.

Flooding. This method consists of spreading sludge as evenly as possible over the surface of the DLD site and then incorporating it with the soil. Two methods of flooding evaluated in 1977 were wild flooding and border-check flooding.[32]

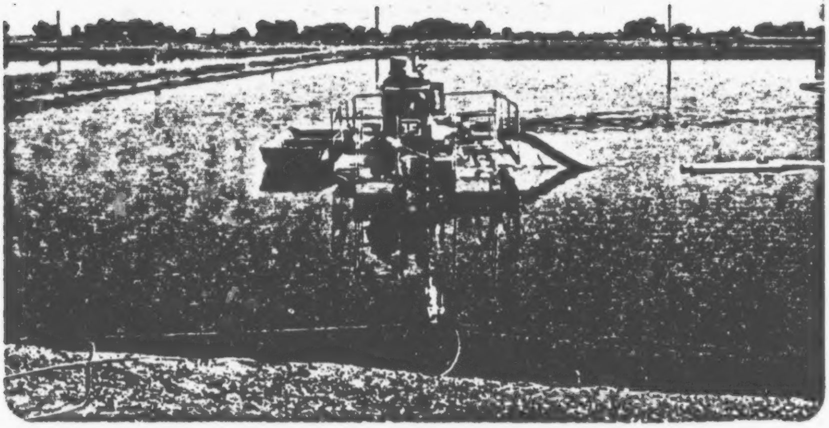
Wild flooding is done more or less in a random fashion. The sludge is discharged at the top end of the field and allowed to flow down slope with the expectation that the area covered will be more or less rectangular. Wild flooding has the advantage of requiring less land preparation, but it has the disadvantage that the flooding is not controlled as well as with border checks. The 1977 operation demonstrated that the wild flooding method did not give adequate control and the sludge spead too far laterally.

Border checks were constructed when the wild flooding method proved to give unsatisfactory distribution patterns. The borders consisted of low dikes about six to eight inches high which ran the length of the field in the direction of flow. Their purpose was to control the lateral spread of the sludge, thus giving more uniform coverage. Various spacings between border checks were evaluated and it was determined that a spacing of 75 ft allowed satisfactory performance and was not unreasonably expensive to build.

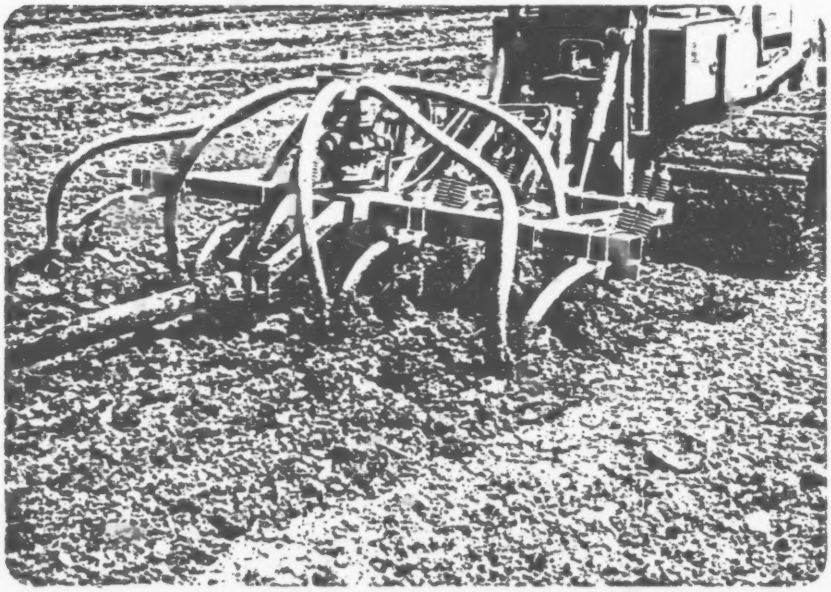
Perhaps the greatest problem associated with the gravity methods of sludge application was that of obtaining uniform sludge coverage at a satisfactory depth. Contributing factors to this problem included field slope, sludge density variations and scheduling of sludge application. Because of the uneven distribution of sludge, considerably more odors were produced with the flooding methods of sludge applications in 1977 than with the subsurface injection method in 1976 or 1978, as discussed below. For 1978 field tests, it was felt that better control over the depth of sludge spread by the flooding method could be attained by mechanical surface spreading.

Subsurface Injection. Subsurface injection sludge disposal systems were tested and evaluated in the 1976 and 1978 field tests. From the 1976 studies, it was determined that subsurface injection was an environmentally sound and economically feasible method for sludge disposal. Two major drawbacks were identified in the 1976 studies: (1) the MC-15 Mudcat dredge could not pump sufficient flow at high solids concentrations, and (2) the injector feed hose had unsatisfactory wear characteristics. In 1978, modified equipment was purchased and evaluated in an effort to correct these shortcomings.

The 1976 subsurface injector was leased and had 7 duckfoot shovels attached to a hydraulically positioned tool bar. This injector was capable of injecting over 600 gpm of sludge about 6 to 8 inches into the ground in a 10-ft wide swath. The sludge was fed to the injector by a 660-ft long, 4-inch diameter hose which trailed behind a crawler tractor as it traversed the DLD site. At the edge of the site, the injection unit had to make a turn which consumed about 10 percent of the total operating time. Traveling at about 1.4 miles per hour, the injector unit covered about 1.6 acres per hour while injecting at a rate of 600 to 650 gpm. The 4-inch diameter feed hose was the weak link in the system.



Mudcat dredge in operation. Note cable in foreground used to position and move dredge across SSB. The flat bottom boat to the left of the dredge is for transportation to and from shore.

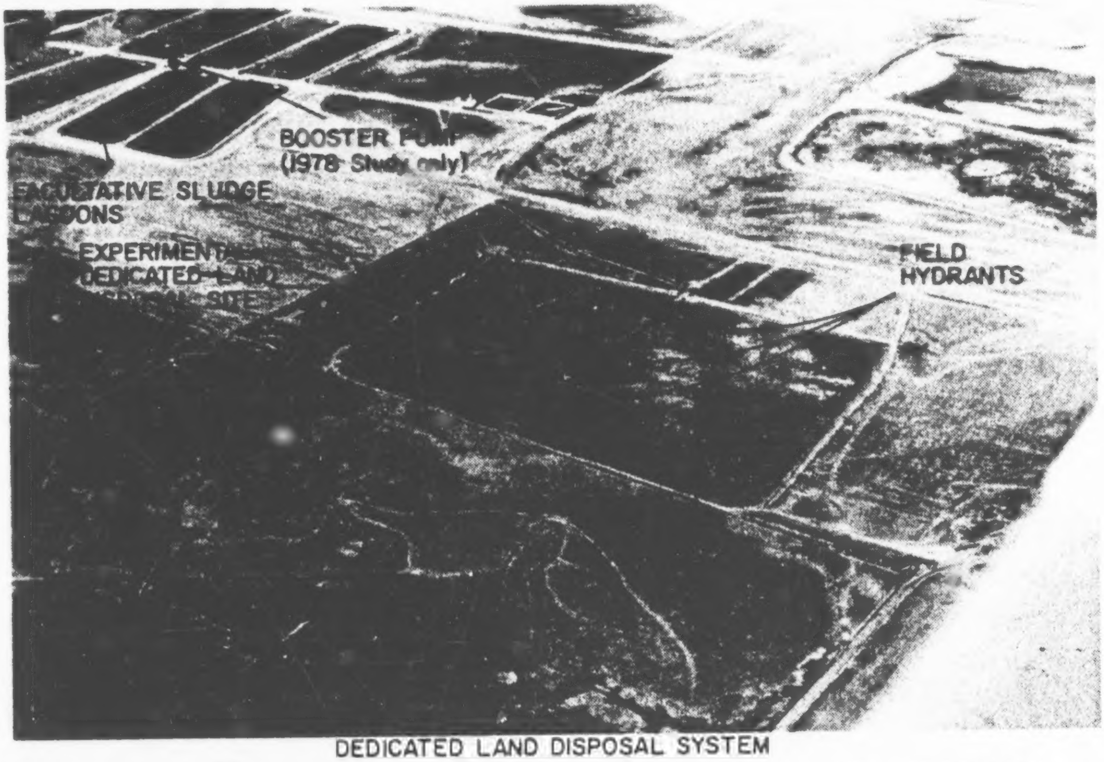


The DLD direct injection equipment showing the injector feed hose which supplies harvested sludge to the unit for incorporation into the soil.

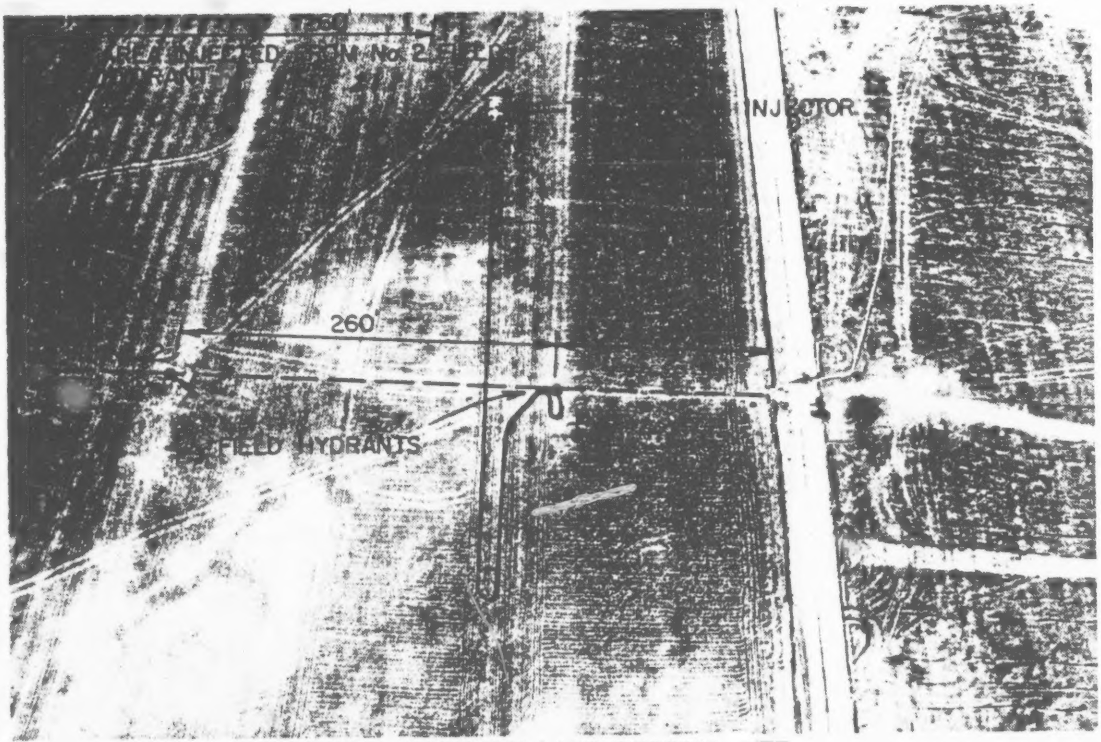
In the 1976 studies, the first hose delivered with the injector wore out in about 2 days. The manufacturer claimed this hose was defective and shipped another hose. This hose was dragged about 300 miles over the course of two months at which time it, too, was worn out. In the 1978 studies, a 4 1/2-inch diameter hose of similar construction was dragged only 80 miles before it wore out. In this case, half of the field had sludge on the surface which should have lubricated the movement of the hose. The manufacturer claims that this hose was also defective. Based on the average hose-life of 190 miles, the hose costs would amount to 10 percent of the total sludge disposal annual costs or about $3.75/dry ton.

The 1976 injection system also suffered from serious material handling limitations. This was due to the low flow rate delivered to the subsurface injector and the low percent solids of the sludge. The low flow rate was solved in 1978 by use of a booster which was installed between the dredge and the injector. The low percent solids was solved by the purchase of a new dredge which had its pump mounted on the end of the boom supporting the auger-cutter head instead of up on the barge with the engine. This modification assured that the sludge from the bottom of the SSB was pushed by the auger-cutter directly into the submerged pump intake and was not required to be sucked up a 15-ft long pipeline to a pump mounted at the water surface. With the older system, thick sludge was pumped; the pump would cavitate and lose its prime. In 1976, the harvested sludge averaged only 4 percent solids. In 1978, an average of 5.3 percent was attained and it appears that an average of 6 percent solids can be obtained with further equipment improvements. Even the 32 percent improvement from 4 percent to 5.3 percent, will result in a 33 percent reduction in the length of time the dredge and injector will have to operate to dispose of a fixed tonnage of sludge at a fixed flow rate, thereby resulting in a significant cost savings.

For the 1978 studies, improvements in the dredge and the addition of the booster pump, as discussed above, were made. The subsurface injector was also larger. Instead of 7 shovels the new



DEDICATED LAND DISPOSAL SYSTEM



DETAIL DEDICATED LAND DISPOSAL SITE

	DEDICATED LAND SYSTEM DB/MAD 2/19

injector had 9 shovels and covered a 13-ft wide swath at a maximun flow capability of 800 gpm when fed through a 4 1/2 in. diameter hose. The 1976 injector was pulled by a 42-hp tractor while the 1978 tractor required 65 hp. Both of these tractors had 30-in. wide crawler tracts for traction and support on soft ground.

Mechanical Surface Spreading and Tillage. Both the 1976 and 1978 subsurface injection studies, while demonstrating that subsurface injection results in an aesthetically pleasing disposal method, were plagued by costly hose wear problems. The 1977 studies showed that if the stabilized sludge from the SSBs could be spread evenly at a maximum thickness of 1 to 2 in. on the soil surface, and then disked in almost immediately, no odor or vector problem would ensue. Therefore, it was concluded that if a mechanical overhead distributing system could be developed that would spread the sludge in such a manner a significant cost savings could be obtained.

To evaluate the aesthetic impacts of mechanical surface spreading the subsurface injector was operated in the out-of-ground position over half of the DLD. A tractor was then used to disk in the sludge. No fly or vector problem resulted from this operation and comparative odor measurements showed no significant difference in odor emissions between the surface spread field and the subsurface injected field. A second advantage to mechanical surface spreading is that the sludge is kept closer to the soil surface which promotes more rapid drying, permiting more frequent sludge applications.

Currently, there are no mechanical surface spreading systems available which will apply the sludge evenly over a field without creating aerosols. A study is presently underway, as discussed below, to evaluate the possibility of modifying a center-pivot irrigation system to spread the sludge evenly over the soil surface without creating aerosol problems.

Fixed Distribution. A center pivot irrigation system consists of a long pipe supported by wheeled towers which rotate about a fixed point in the center of a field. The booms range from 100 to 2500 ft in length. As used in a water irrigation system, sprinklers are spaced out along the boom so as to provide for the complete coverage of the field in each pass. To modify the system for sludge, a series of pipes would have to be tapped in the bottom of the pipe and fitted with baffle plates similiar to a water truck used for dust control on a construction site. Several problems need to be solved before this system can be fully operational. A minimum pipe size and baffle plate design must be developed that will not plug or create aerosol problems. Tests have shown that a 7/8-inch diameter nozzle is the minimum size that is compatable with existing center pivot systems. A coarse screen or grinder will be required to remove particles larger than 7/8 inch diameter to insure nonclog operation. By operating the nozzels at approximately 10 psi the aerosol and associated odor problem will be minimized. Using 7/8-inch diameter nozzles and a screen or grinder to remove larger particles, a center pivot irrigation system can be modified to spread sludge.

Design and Operational Criteria. Recommendations for design and operation of the existing and future DLD sites using the subsurface injection method of sludge application have been developed and are presented in Appendix C. These recommendations have been consolidated from previous SSMP reports and technical papers and modified as necessary in view of recent information developed during predesign of Phase 1 DLD sites.

MISCELLANEOUS USE DETERMINATIONS

There are five basic categories of pathogens and parasites which can be found in sludge: bacteria, parasitic protozoans and their cysts, helminths and their eggs (ova), pathogenic yeasts, and viruses. Task 6 of the SSMP, termed the miscellaneous use determinations, involved two subtasks which were conducted by SAC's subcontractor, Spray Waste Inc.; 1) a microbiological study including a monitoring program capable of meeting proposed federal, state and local environmental and public health requirements, for determining the effectiveness of the proposed sewage sludge processing system in destroying selected index microbiological organisms and providing direction towards sludge management practices which could achieve a cost-effective, public health hazardless, sludge disposal system, amd 2) a virus study including a monitoring program capable of meeting the same criteria for virus as outlined above for microbiological organisms.

The microbiological and virus studies were originally included in the SSMP to provide the District with information to determine if safe use could be made of the SSB stored and DLD applied liquid sludge. It was anticipated this knowledge would provide the District with the flexibility of allowing the SSB harvested sludge to be used for nonedible agricultural crops. This knowledge would then be used to backup the two major alternatives for sludge processing and disposal being covered in the SSMP EIR. Both of these alternatives advocated on-site disposal without public contact.[42] For this reason, when it became necessary to achieve a savings necessary to finance the 1978 supplemental SSB odor studies the miscellaneous use determinations became of secondary importance to the development of a cost-effective and environmentally acceptable SSMP for the Regional Plant and work on these subtasks was stopped at the end of 1977.

Valuable information was obtained, however, during the course of the two years of miscellaneous use determinations. This information documented the effectiveness of the Central plant's solids processing system in reducing the populations of various types of microbiological organisms. The virus studies, due to the extreme difficulty of preparing representative samples by state-of-the-art techniques, were inconclusive even though very few viruses were detected. This information is summarized below.

Microbiological Studies

The microbiological studies involved an intensive monitoring program during 1976 and 1977, as a result, two annual reports were prepared.[38,39] Media sampled included raw, digested, stored and harvested sludge; SSB supernatant; treated and untreated soils at the DLD site; and Morrison Creek water. In 1977 alone, a total of 66 samples were submitted for bacteriological and helminth/ protozoan analyses.

An illustration of the type of data obtained during this surveillance program is shown on Figure 2-4. In the figure, 1977 values for Fecal coliform populations are shown as a function of location in the treatment and disposal process. This process was documented to be making approximately a 7-log decrease (99.999 percent) in the Fecal coliform population from the raw sludge to the treated soil stage. Data for the SSB sludge were obtained by compositing samples from throughout the basin profile, whereas data for harvested sludge were determined from sludge taken from the bottom of the basin. Harvested sludge is older and more stabilized and, as can be seen in the figure, was shown to have much smaller Fecal coliform populations, indicating the considerable bacterial inactivation capacity afforded by SSBs.

Only three of 55 and two of 66 samples examined in 1976 and 1977 resulted in the positive detection of helminth ova. However, these data were judged to be inconclusive because (1) only a single species was detected (Toxocara canis), (2) a very low density of ova was detected, and (3) the data were very atypical from those collected at other locations in northern California and throughout the country. The absence of pathogenic protozoa in all samples indicates they do not likely survive the digestion process, but if they do, they are extremely short-lived in the SSBs or soil environment.

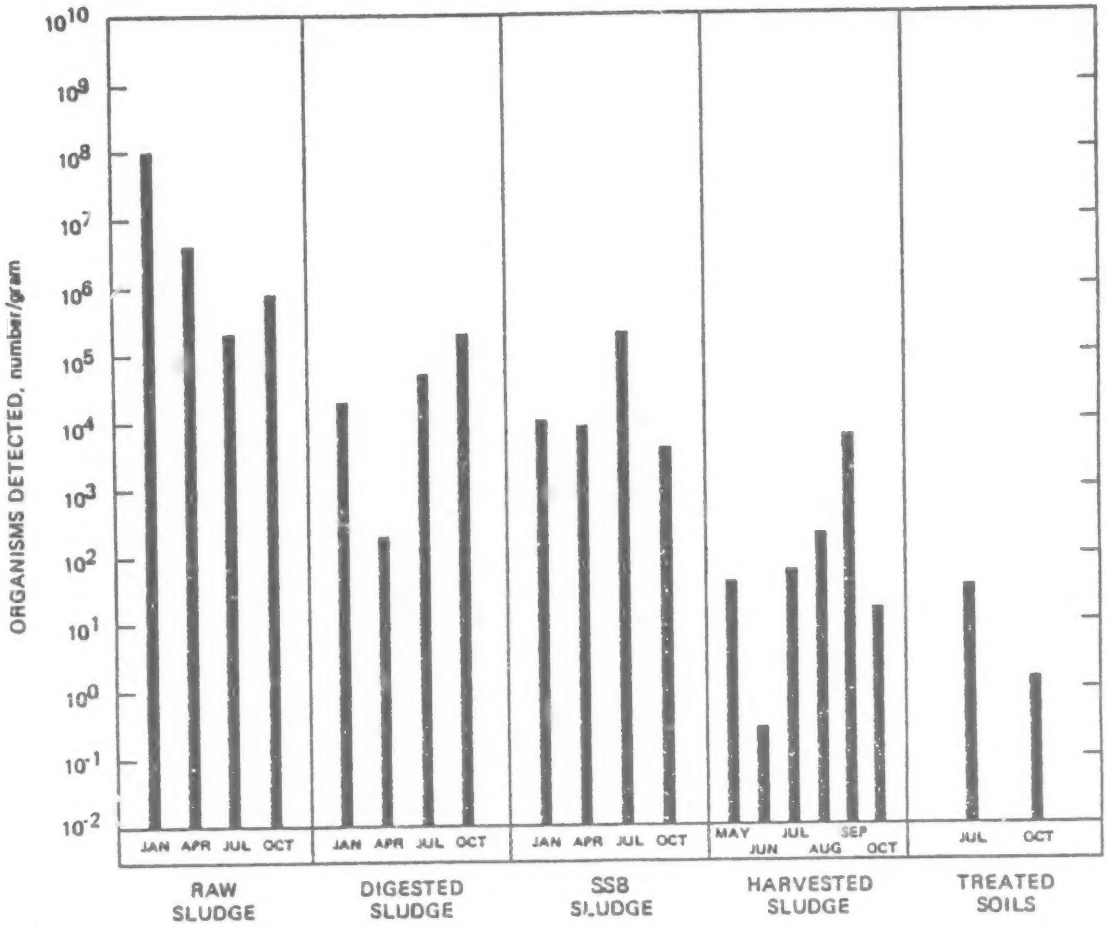


Fig. 2-4 Typical Fecal Coliform Populations as a Function of Location in the Treatment-Disposal Process

Virus Studies

Except for the exclusion of DLD site soils, the virus studies utilized the same monitoring program as that employed for the microbiological studies. During the initial phases of the virus study, Hepatitis-B (HB_sAg) was used as the index virus. Through controlled experiments, discussed in detail in the first annual report,[40] different mediums and various laboratory procedural steps in the detection process for HB_sAg were examined. From this analysis, the expected virus recovery rate associated with each step and sample state was identified so that procedural reproducibility of techniques could be obtained.

Results from the initial experiments, however, showed apparent low HB_sAg recovery rates with analyses involving sludge. This may account for the analytical results from sludge samples collected at the Central treatment plant being at the margin of viral detectibility. Additional controlled experiments were then conducted. A high-speed blender (Polytron) was employed to disassociate the adsorbed HB_sAg from the solids fraction as a means of increasing the recovery rate. Using this Polytron technique, about three times greater recovery was obtained.

In their review of the first annual report, the State Department of Health (SDH) expressed considerable doubt as to the usefulness of using HB_sAg as a means of monitoring viruses. Despite evidence in the literature that HB_sAg can be found in sewage, convincing the SDH that HB_sAg detection was a viable method of virus surveillance would have required the production of considerable scientific evidence, without meeting SSMP objectives. Therefore, even though no standard methods for virus surveillance were available, it was decided for 1977 to employ the more conventional methods of enteric virus detection as a surveillance tool for the SSMP.

A report was subsequently prepared on the 1977 enterovirus surveillance studies.[41] During the 1977 studies, it was found that to successfully prepare a sludge sample for innoculation onto virus host tissue culture, it is first necessary to (1) disassociate the virus particles which tend to attach to the sludge solid particles, (2) remove organic materials which are toxic to the cell cultures, and (3) concentrate the sample by removal of nearly all water. Spray Waste, in association with Dr. George Jordan of the U.C. Medical Center, extensively modified the state-of-the-art preprocessing procedures. Development of a technique with organic extraction of the sludge samples significantly increased virus recovery. One of the conclusions of their work in 1977 was that further refinement in the current sewage standard methodology for the detection of enteroviruses in sludge is necessary at the research level. They also concluded, however, that inability to detect viruses in the majority of samples, did not allow the implication to be made that no infective viruses were present.

ENVIRONMENTAL IMPACT REPORT

Preparation of the EIR was Task 7 of the SSMP; the draft EIR was published in October, 1978[42] and the final report in January 1979.[43] Discussion is presented below which summarizes the project alternatives considered in the EIR and the major environmental effects of the recommended project.

Purpose of Study

The purpose of the EIR was to compare and contrast the environmental, social, economic and engineering considerations of several post-digestion sludge alternatives in order that the most cost-effective and acceptable solution would be undertaken and that adequate safeguards would be included in the recommended project design and operation. It was expected ash disposal would generally follow the recommended sludge disposal alternative.

Project Alternatives

The major alternative to the recommended project, and the one which would probably have been recommended had the public review process resulted in rejection of the SSBs based on the potential risk of off-site odors or groundwater degradation, involved the mechanical dewatering of digested sludge and its on-site disposal in trenches or by other potentially low odor methods. This alternative (Alternative IB), had several disadvantages including:

- Over 30 percent higher total annual cost than the recommended project.
- More material to be disposed of and greater use of land in the long-term for disposal purposes.
- Greater chance of groundwater contamination due to disturbance of underlying soil layers through the extensive use of trenching landfill-type operations.
- Potential Sacramento River and Delta water quality degradation during some periods of the year caused by recycling, treatment and discharge of centrate produced in the dewatering process.

Alternatives Rejected. Two other disposal-only alternatives were evaluated:

- Dewatering and transport to the county landfill (25 mi one-way) for disposal. (Alternative IA) The cost of this alternative was similar to the dewatering and on-site disposal alternative but had the additional disadvantages of refuse landfill capacity usage and off-site transportation impacts.

- SSBs and on-site permanent lagoons. (Alternative IIC) The cost of this alternative was slightly more than the recommended project and the alternative had the environmental impact of having significantly greater off-site odor risk due to greatly increased water surface area.

Three reuse alternatives were evaluated. Potential regulatory restrictions prevented serious long-term considerations of these options at this time. These alternatives included:

- Dewatering and summertime agricultural land spreading - winter on-site disposal (Alternative IC). The cost of this alternative was greater than all other alternatives. It involves the reuse of only half the sludge produced.

- Dewatering and partial (20 percent) composting and reuse, remaining on-site disposal (Alternative ID). The cost of this alternative was similar to Alternative IB.

- SSBs and summertime agricultural land spreading of liquid-based sludge (Alternative IIB). Although this alternative was the most expensive SSB alternative, it did involve recycling the maximum amount of nutrients to the land. When the energy saved in fertilizer production was taken into account, this alternative had the least energy use.

Comparison of Recommended and Alternative Projects. A comparison of the recommended project (Alternative IIA) and the major alternative project (Alternative IB) is included in

Table 2-9. This table reviews the most important factors used in making the final selection between alternatives.

No Project Alternative. If none of the alternative sludge disposal system were implemented, the existing system used at the Central Wastewater Treatment Plant would become overloaded immediately upon commissioning of the Regional Plant. Odors would probably be emitted from the existing SSBs, probably causing off-site complaints. Eventually, solids would be recycled through the Regional Plant resulting in overloading and upset of the liquid processing system. This would result in effluent quality degradation and adverse impacts in the receiving waters (Sacramento River).

Recommended Project

Facilities proposed to be constructed at this time would be expected to handle solids processing and disposal up to 1992. These are termed Stage I facilities. Expansion of these facilities is planned for 1992 to handle increases in sludge production. The site is expected to handle all solids produced to the year 2020, although the planned facilities are expected to need additional enlargement in the year 2000.

Project Description. Stage I facilities include the following:

- Twelve additional SSBs. Together with the 8 existing SSBs, 124 surface water acres would be available to handle the volatile solids loading from the Regional Plant digesters. The SSBs include surface mixers, barrier walls and wind machines for operational reliability, odor control, and odor dispersion.

- One additional digester operated as a storage and blending unit for odor control (storage unit minimizes short-circuiting of sludge through the digesters).

Table 2-9. Comparison of Recommended and Alternative Projects

Element	Recommended project (IIA)	Alternative project (IB)
Cost:		
Total annual cost - 20 yrs.	4,753,000	6,569,000
Stage I[a] escalated capital costs, million dollars	21.5	36.6
Stage I local capital cost share, million dollars	5.6	8.5
Annual cost impact per residence, dollars, 1985	4.90	7.10
Land use; 20 year program		
All solids disposal and related needs, acres	610	660
Buffer land needs, acres	850	775
New land acquisition, acres	902	877
Water surface area on-site		
Process facilities, Stage I, acres	124	0
Runoff detention, acres	20	20
Consistency with land use plans	Buffer land needs intrude on proposed residential and commercial areas.	Buffer land needs intrude on proposed residential and commercial areas.
Groundwater effects	Situation is controlled - No adverse effects	Leachate from trenching unknown at this time; but expected to be greater leachate potential than recommended project.
Odors	Appears to be controlled with extensive mitigation measures. Confirming experiments now underway.	Probably no adverse effect with on-site controls. However, impact somewhat unknown at this time.
Surface water quality	Recycle streams are limited to fall and winter months. Little, if any, adverse effects.	Dewatering recycle stream would add 450 tons NH_3-N to Sacramento River annually (1992). Would be slight increased algal growth in Delta.
Plant operation	SSBs provide beneficial buffer between liquid processing streams and solids disposal.	Recycle stream may tend to upset liquid processing at times - reduces plant reliability.
Operational energy use, Btu/yr	5.4×10^{10}	6.3×10^{10}
Bird hazard to aircraft	Study underway - significance unknown.	No adverse effect.
Loss of habitat	700 acres changed including elimination of on-site drainage course.	700 acres changed including elimination of on-site drainage course - revegetation of trench areas could mitigate to some extent.

[a] Stage I is the period from 1980 to 1992.

- Vacuum vaporization facilities to strip odors and remove debris from digested sludge before discharge to SSBs.

- Dedicated land disposal (about 185 acres). Land preparation and installation of piping and sludge transfer equipment would provide for the summertime spreading of sludge and its subsequent incorporation into surface soil layers.

- Ash, grit and screenings landfill. A separate 15-acre landfill, would be developed on-site to handle ash production and, when the incinerator is not operating, dewatered grit and screenings.

- Flood control levee. A levee would be constructed to protect the sludge disposal site from the flooding of Morrison Creek and in case of a major river levee failure of the Sacramento River.

Land acquisitions are needed to the south and southeast of the existing Regional Plant to provide buffer and future disposal sites. About 900 acres have been identified as being required. Most of this land is necessary to "buffer" solids processing and disposal facilities from proposed nearby residential development.

Major Effects of the Recommended Project. The major effects of the recommended project include changes in land use, odor risks and groundwater contamination. Land use impacts involve the direct change in use of about 525 acres from agricultural to dedicated solids disposal. Also affected are buffer lands to the east of the Western Pacific Railroad, which would probably be developed for residential and heavy commercial use if on-site solids disposal is not implemented. An on-site drainage course which includes a seasonal riparian habitat would be eliminated.

Odors were a major concern with the recommended project. These involved principally the large emission areas of the SSBs and ESB. Table 2-7 presented the final estimated odor risk for the SSB-ESB system. It indicates the acceptable odor risk as evidenced by the certification of the final EIR and approval of the recommended project by the Regional District Board of Directors.

Groundwater protection will be maintained through the following techniques:

- DLD operation will be limited to the surface soil layers, thereby avoiding disturbance of highly impermeable soils found beneath the surface.
- Ash, grit and screenings landfill will be lined with clay if excavation beneath hardpan layers is required.

Surface water protection will be assured through the following:

- Detention of all potentially contaminated precipitation runoff from about 200 acres of DLD and landfill area and the recycling of the collected runoff for treatment to the SSBs or directly to the Regional Plant prior to its discharge to the Sacramento River.
- Minimizing recycling of SSB supernatant through use of in-basin storage and evaporation. Recycling would normally occur only in fall and winter months and the amount of precipitation would largely determine the amount of recycle.

Stage I escalated capital costs for the recommended project are estimated to be $15.1 million less than for the alternative project (Alternative IB). The local share, after state and federal grants are provided, is $2.9 million less with the recommended project, and the cost to local residents would be about $2.20/yr less. The costs to residents are user charges to cover the local capital and operational costs of the project.

Certification of the SSMP EIR

The SSMP draft EIR was submitted to the District in October 1978. Following this submittal, the EIR review process was initiated whereby federal, state and local agencies, and the public were given opportunity to review the report. Because of the odor implications of the recommended project to the surrounding residential areas, a public workshop was held in the community on December 6, 1978, to review the project and solicit public input. Then, on December 11, the draft EIR was formally presented to the Regional District Board of Directors and interested parties were invited to present their views to the Board.

Pertinent comments received, both written and oral, were addressed and included in a supplemental report which, together with the draft EIR, constituted the final EIR. The supplemental report also included additional information, not included in the draft EIR, which was produced as a result of on-going investigative work. On January 22, 1979, the final EIR was presented to the Board for certification and adoption of the recommended project. The Board did certify the EIR and approve the recommended project for incorporation into the Regional Plant's solids processing and disposal system.

CHAPTER 3

IMPLEMENTATION OF THE REGIONAL PLANT SOLIDS PROCESSING AND DISPOSAL SYSTEM

As indicated in Chapter 2, the culmination of the SSMP has been the certification of the final EIR and adoption of the recommended solids processing and disposal system. With Regional Plant start-up scheduled for January 1980, design and construction of the necessary solids facilities must proceed in a timely manner to assure adequate capacity. Discussion in this chapter is directed at the implementation schedule of the approved project, including a consideration of the necessary permits which must be acquired.

IMPLEMENTATION SCHEDULE

The approved project consists of 12 additional SSBs, one additional digester operated as a storage and blending unit, vacuum vaporization facilities, dedicated land disposal areas, an ash, grit and screenings landfill, and a flood control levee. These facilities, termed Stage I facilities, are planned to handle Regional Plant solids production up to the year 1992.

Integration of Recommended Project into Plant Start-Up

Due to limited time remaining prior to Regional Plant start-up, design and construction of a good portion of Stage I facilities must be conducted on a rapid schedule. Stage I facilities have therefore been divided into Phase I and Phase II facilities designed to accept projected Regional Plant sludge production and each of which has a specific time schedule designed to provide a smooth transition with Regional Plant start-up. Figure 2-1 illustrated the location of Phase I and II facilities at the Regional Plant site; a time schedule for design and construction of these facilities is presented in Table 3-1 and is discussed below.

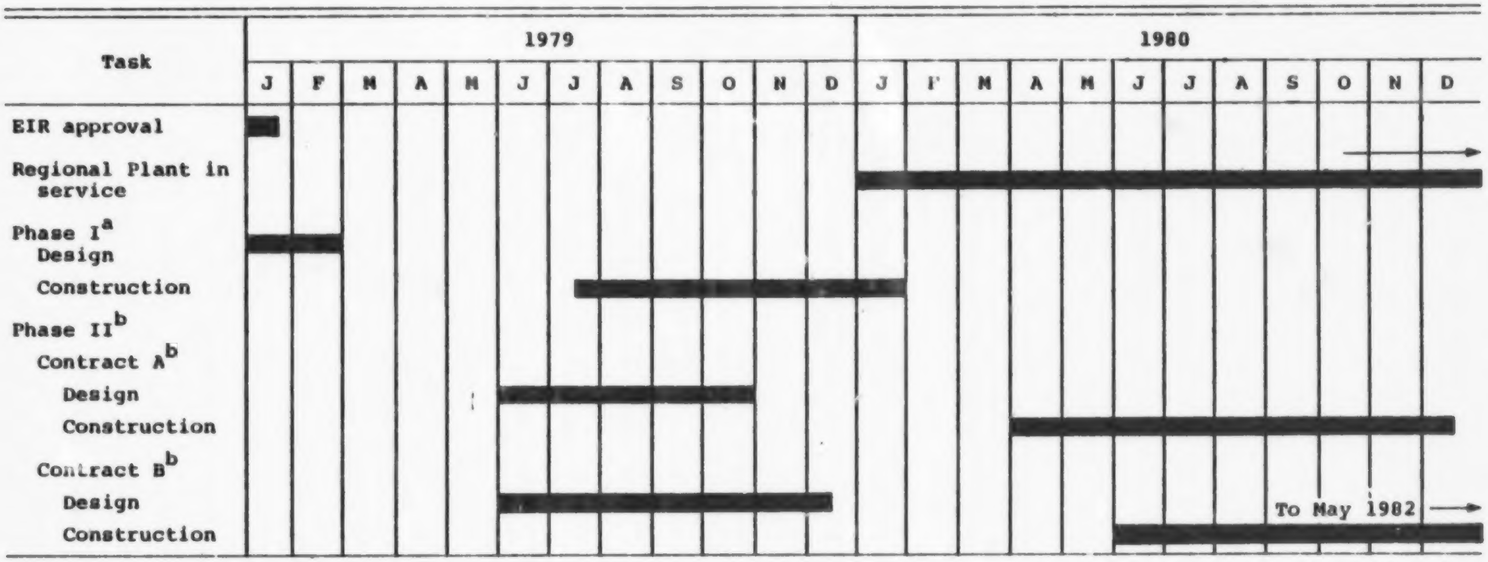
Phase I SSBs. The limited time remaining prior to plant start-up requires most of the new SSBs to be constructed on a rapid schedule. Eight SSBs are needed in Phase I in order to assure sufficient loading capacity to process the sludge generated during the initial start-up of the Regional Plant. Based on the projected SRWTP 1981 average annual sludge production, 55 additional surface acres of SSBs (there are 40 existing acres) are needed in Phase I. This surface area will be provided by the eight Phase I SSBs which have 7 surface acres each. All eight of these basins can be constructed on property currently owned by the District, thereby assuring no property acquisition holdup for the certification of federal and state funding.

The eight SSBs will be built to include all the necessary facilities, i.e., barriers and wind machines, operator amenities, and supply and sludge harvesting piping. All piping and conduits which are to be incorporated into the SSB levees to be constructed as part of Phase I facilities will be installed immediately to avoid Phase II construction within the levees. Pipelines will also be stubbed out where necessary to allow for the future connection of Phase II facilities.

Final design of the eight basins has been proceeding since October 1978 and final design was completed by March 1, 1979. Construction is scheduled to begin in June and be completed in January of 1980.

Other Phase I Facilities. Other Phase I facilities will include the layout and rough grading of three DLD areas, the final detail grading of one of the areas complete with harvesting and

Table 3-1. Design and Construction Schedule for the Regional Plant Solids Processing and Disposal Facilities



[a] Phase I facilities includes construction of 8 SSBs, 3 DLD sites (piping installed in one site only) and associated piping, wind machines and barriers.

[b] Phase II facilities will be constructed under two contracts. Contract A includes 4 SSBs, completion of 2 DLD sites, preparation for 2 additional DLD sites, flood control levee, road access, drainage, wetlands compensation area, agricultural land development, piping modifications to existing 8 SSBs, ash, grit and screenings landfill, and equipment storage. Contract B facilities includes vacuum vaporization facilities, blending digester and telemetry hookup.

drainage pipings, necessary site flood protection work and a supernatant and runoff return system to the City interceptor. These three categories of facilities are discussed below:

DLD areas:

- Spreading excess soil excavated from the SSBs on the three DLD areas on currently owned property or in stockpiles as needed and finished grading of one DLD area.
- Constructing sufficient harvesting piping to make one DLD usable for the summer of 1980 or until all DLDs are operational.
- Routing on-site uncontaminated drainage around the southeast corner of Phase I facilities and along the existing southern property line to discharge to the borrow pit. This is a temporary drainage program to handle runoff until final facilities are constructed in Phase II.

Flood control levee:

- Construction of flood control levees where identified as immediately adjacent to SSB levees. This is needed to protect SSB levees at lower elevations where flooding occurs almost annually.
- Construction of the portion of the flood control levee connecting the new group of eight SSBs with the existing group. This is needed to protect SSB levees otherwise subject to flooding damage and to keep the finished DLD area from flooding.

Supernatant and drainage return system:

- Construction of new SSB supernatant return and DLD drainage system to provide return to the City interceptor. This system will be designed to provide positive control for SSB supernatant return flow and independent measurement for SSB supernatant and DLD runoff drainage flows and the necessary DLD runoff piping to connect the usable DLD site to the supernatant return system.

Phase II Facilities. Phase II facilities have been divided into two construction contracts because of the nature of the work involved; scheduling for coordination with existing plant construction work and other issues are identified below. As indicated in Table 3-1, these construction contracts are referred to as contract A and contract B.

Contract A would include the remaining four SSBs, remaining DLD and flood control levee work, road access and drainage, wetlands compensation area, agricultural land leveling, modifications for existing SSBs, ash, grit and screenings landfill work, and equipment storage area. This would be primarily an earthwork contract which could proceed quickly to bid in late 1979 or early 1980, so that completion of construction during 1980 is assured. Reasons for moving these things along quickly to construction include:

- Having all SSBs available at an early date to take full SRWTP digested sludge load. Also, the final four SSBs might be used during later 1980 to allow some existing SSBs (maybe four at a time) to be taken out of service and water level dropped, so that work in existing SSB levees could be accomplished most effectively.

- Pressure from State Fish and Game/U.S. Fish and Wildlife to get the wetlands compensation area settled as soon as possible.

- Pressure from the dairy operator (Mr. Ben Parker) to bring new land into production (possibly for a summer, 1980 crop since we would be removing about 90 percent of his cropland as of spring, 1980).
- Need to finish the flood control levee system before the winter of 1980.

Contract B would include vacuum vaporization facilities, blending digester and telemetry hookup of the facilities to the Regional Plant computer. This would be primarily a mechanical facilities contract where the work may be more appropriately initiated slightly later than contract A to minimize interfacing problems with existing construction work. Construction of these facilities would occur between June 1980 and May 1982.

Permits and Approvals

Over 3 years of investigative work has been completed in the SSMP to fully explore the engineering and environmental aspects of the SSB-DLD system. As indicated in Table 2-1, a large number of permits and approvals must still be obtained from various regulatory agencies prior to implementation of the approved project.

The action of the Regional Water Quality Control Board, Central Valley Region, in issuing waste discharge requirements, provides the basic regulation of water quality. No NPDES permit is needed since there is no point discharge of waste to surface waters. Nonpoint discharges to the surface waters from the DLD sites are contained by the flood control levee.

Regulation of flood control levee design and floodplain impacts is controlled by the State Department of Water Resources, Division of Dam Safety, and the County Division of Water Resources, respectively. Regulation of off-site drainage modifications is also controlled by the county.

The filling of seasonal wetland areas at the site is controlled mainly through the issuance of the U.S. Army Corps of Engineers Section 404 permit. The Regional District is obliged to meet both state and federal regulations concerning wetlands protection whereby impacted areas must be mitigated. These needs will also be coordinated to ensure that the mitigation area produced is satisfactory to all federal, state and local agencies.

Solid waste regulations require that the proposed project be incorporated into the County Solid Waste Mangement Plan. Also, a landfill operating permit will need to be issued by the State Solid Waste Management Board prior to operation of the proposed disposal facilities. A county special use permit will be needed for each phase of the project. There are no air pollution control regulations which apply to the project. Likewise, state and local health officials have no specific approvals to provide for the project but have offered general guidance which indicates daily covering of sludge is highly desirable.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

No.	Subtask	
1		Sacramento Area Consultants, Study of Wastewater Solids Processing and Disposal, prepared for the Sacramento Regional County Sanitation District, June 1975.
2	1.2	Sacramento Area Consultants, Work Plan and Proposal for the Sewage Sludge Management Program, prepared for the Sacramento Regional County Sanitation District, October 6, 1975.
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4		Sacramento Area Consultants, Revised Work Plan and Proposal for the Sewage Sludge Management Program, prepared for the Sacramento Regional County Sanitation District, December 10, 1976.
4a		Sacramento Regional County Sanitation District Board of Directors, Resolution SR-121, Authorization to Execute Amendment 10 to Agreement for Engineering Services with Sacramento Area Consultants, January 10, 1977.
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5		Sacramento Area Consultants, Supplemental Study: Sewage Sludge Processing and Disposal for the Sacramento Regional Wastewater Treatment Plant Sewage Sludge Management Program, prepared for the Sacramento Regional County Sanitation District, January 25, 1977.
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7		Sacramento Area Consultants, Recommended Program Revisions for the Sewage Sludge Management Program, prepared for the Sacramento Regional County Sanitation District, May 30, 1978.
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11	3.3	Sacramento Area Consultants, Review Draft - Task Report, Source Survey Phase I, prepared for the Sacramento Regional County Sanitation District, February 9, 1978.
11a.		Sacramento Area Consultants, Review Draft-Task Report, Source Survey Phase II, prepared for the Sacramento Regional County Sanitation District, June 5, 1979.
11b.		Sacramento Area Consultants, Final Report, Source Survey Phase I and II, prepared for the Sacramento Regional County Sanitation District, September 18, 1979.
12		Sacramento Area Consultants, Review Draft - Task Report, Source Survey Phase II, prepared for the Sacramento Regional County Sanitation District, February 27, 1979.
13	4.1	Sacramento Area Consultants, Experimentation on the Value of Mechanical Surface Mixers, letter report prepared for the Sacramento Regional County Sanitation District (included as Appendix F in Reference 30), October 26, 1977.

No.	Subtask	
14		Sacramento Area Consultants, 1978 Mixer Study, letter report prepared for the Sacramento Regional Wastewater Management Program (included as Appendix B of Reference 31), December 18, 1978.
15	4.2	Sacramento Area Consultants, Review Draft - Task Report on the Solids Storage Basin Experimental Studies, prepared for the Sacramento Regional County Sanitation District, February 9, 1978.
16	4.3	Baier Agronomy, Inc., Study of Sludge Pond Permeability, prepared for Sacramento Area Consultants, April 1976.
17		Baier Agronomy, Inc., and Sacramento Area Consultants, Review Draft - Task Report, Study of Solids Storage Basin Bottom Permeability, prepared for the Sacramento Regional County Sanitation District, February 9, 1978.
18		Lowry & Associates, Geotechnical Investigation - Dedicated Land Disposal Site, prepared for Sacramento Area Consultants, August 29, 1978.
18a		Lowry & Associates, Geotechnical Report - Perimeter Embankment and Solids Storage Basins, Vol. I, II and III, prepared for Sacramento Area Consultants, January 26, 1979.
18b		Sacramento Area Consultants, Advanced Site Planning Report, prepared for the Sacramento Regional County Sanitation District, February 27, 1979.
19	4.4	Eutek, Inc., Diurnal Odor Evaluations at the Solids Storage Basins, prepared for Sacramento Area Consultants, December 1975.
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28	4.7	Hovater-Way Engineers, Inc., Feasibility Study of Covers for Solids Storage Basins, prepared for Sacramento Area Consultants, December 1975.
29	4.8	Sacramento Area Consultants, First Annual Report on Solids Storage Basin Operation and Peformance, prepared for the Sacramento Regional County Sanitation District, January 25, 1977.
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No.	Subtask	
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37		Lowry & Associates, Geotechnical Engineers, Groundwater Observation Wells for the Dedicated Land Disposal Site, prepared for Sacramento Area Consultants, November 1977.
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41		Spray Waste, Inc., Summary Draft Task Report on the Enterovirus Surveillance Studies, prepared for Sacramento Area Consultants, February 9, 1978.
42	7.1	Sacramento Area Consultants, Draft Environmental Impact Report, Sewage Sludge Management Program Wastewater Solids Processing and Disposal, prepared for the Sacramento Regional County Sanitation District, October 1978.
43		Sacramento Area Consultants, Environmental Impact Report (Supplement to Draft Evnvironmental Impact Report, October 1978) Sewage Sludge Management Program Wastewater Solids Processing and Disposal, prepared for Sacramento Regional County Sanitation District, January 1979.
44	Technical paper	Uhte, Warren R., Wastewater Solids Storage Basins, A Useful Buffer Between Solids Stabilization and Final Stabilization, presented at the 48th Annual Conference of the California Water Pollution Control Association, Lake Tahoe, California, April 14, 1975.
45		Sacramento Area Consultants, Flood Hazard Analysis and Report for the Sacramento Regional Wastewater Treatment Plant, prepared for the Sacramento Regional County Sanitation District, March 1975.

APPENDIX B

RECOMMENDATIONS FOR SSB DESIGN AND OPERATION

APPENDIX B

RECOMMENDATIONS FOR SSB DESIGN AND OPERATION

The following recommendations for design, operation and monitoring of future and existing SSBs have been developed as a result of over 3 years of continuing evaluation of SSB operation and performance. These criteria have been consolidated from previous SSMP reports and technical papers and modified as necessary in view of recently developed information. The criteria are enumerated below along with brief justifications for their inclusion.

Design

1. SSBs should be constructed to a maximum depth of 15 ft and a maximum size of 7 acres.

   Justification: Fifteen ft is the maximum depth from which sludge can be effectively pumped using the type of dredge currently available.[14] The SSMP Draft EIR notes that the 12 additional SSBs (each 7 acres) for Stage 1 development of the Regional Plant will constitute 84 acres, bringing the total SSB surface area to 124 acres.[21] Basins of this size will significantly increase the sludge storage life of an SSB without preventing the basin from operating in a facultative manner. Larger areas (greater than 7 acres) would have the disadvantage of effectively minimizing the SSB surface area available for loading during summer harvesting operations which will involve four basins each year.

2. The bottom and submerged side slopes of the SSBs should be provided with at least a 2-in. by 6-in. clay layer.

Justification: Previous monitoring and investigative work have produced conclusive evidence that the existing SSBs do not leak and, in fact, seal themselves after only several months of operation.[8,9,13,14] However, providing clay layers for bottom and submerged side slopes of future SSBs will be precautionary in nature and constitute an added degree of protection for local groundwater resources.

3. SSBs should be constucted with a 3-ft freeboard and 3:1 dike side slopes as well as special dike earthwork specifications. Riprap protection should be provided (elevation 113.0 to 116.0) to protect the dike slopes from excessive wave action.

   Justification: The freeboard and dike side slope design considerations are dictated by state dam safety requirements. All have been incorporated into the existing SSBs and were discussed in a technical paper prepared in 1975.[32]

4. Three digested sludge supply pipelines should be provided for the SSBs.

   Justification: Providing the SSBs with three sludge supply pipelines will assure that the maximum digested sludge flow from the Regional Plant can be fed to three basins at once. This arrangement will make it possible for the digested sludge to be fed to the basins during those hours when it will not increase the risk of nuisance odors reaching the surrounding neighborhoods.[27] Supply pipeline layouts should be arranged as follows: (1) to allow any one pipeline to feed up to two sets of eight basins (including future SSBs to be constructed in 1992), and (2) to assure that no basins need to be taken out of service due to an individual supply pipeline failure.

5. Two feed points should be provided for each SSB (one at the north and one at the south end) and should be designed to extend from the levee to the center of the basin and discharge in an upward vertical direction. Feed piping should be set flush with the basin bottom.

   Justification: Existing SSBs have three feed points and it was recently recommended that future basins also have three feed points.[14] However, it is now believed that two feed points will be adequate; one feed point to be routinely used for daily SSB loading with surface mixers acting to evenly distribute the sludge feed throughout the basins, and a second feed point so that basins may be fed at twice the anticipated maximum flow rate per basin (1,000 gpm). This additional flexibility will assure the maintenance of the acceptable risk feeding hours (see operational criteria) over the entire life of the basins. Center feed points will assure maximum uniform distribution of the feed sludge. Flush mounting of pipeline exits will minimize feed pipe interference with dredge harvesting operations.

6. All future SSBs should be designed with a constant water surface elevation of 114 ft.

   Justification: Having all basins with a constant water surface elevation will alleviate any accidental transfer of sludge or supernatant between basins. A constant water surface elevation will also assure the successful operation of the in-basin supernatant storage system and the automatic 24 hours per day supernatant control system.

7. The top of the basin levees should be at elevation 117.5 ft with a top width of 25 ft generally and 50 ft as needed.

Justification: The basin levee elevation of 117.5 ft will assure adequate flood-hazard protection.[20] The specified widths of the levees will assure the necessary space to accommodate piping, barrier walls, wind machines, personnel facility trailer and electrical substations, and provide necessary working area and turn capability for flatbed trucks which will carry the booster pumps and dredges from basin to basin.

8. Each digested sludge feed point to each basin should be provided with a remote-controlled valve which allows the plant staff to control the feed at the individual SSB from the plant control center (PCC). In the event of computer failure, feeding operations would then be controlled from the area control center (ACC) No. 8/13, otherwise referred to as the digester control complex. All remote control valves should be located in valve boxes designed to provide direct access for manual operation and maintenance.

   Justification: Controlling the feed to the individual SSBs from the PCC or ACC No. 8/13 is required to assure equal basin loading and more efficient use of work force. During periods of unfavorable meteorological conditions, operators will be able to quickly terminate loading so that conditions which potentially could result in odor complaints can be avoided.

9. All SSBs should be surrounded with 12-ft high, solid, sharp-edged barriers. Barriers should be erected around configurations of four or eight basins. Maximum barrier enclosures should consist of eight basins. Barriers must provide a complete enclosure and be built with at least one 16-ft wide access with a sliding or roll-up door and several other 10-ft wide accesses with removable partitions.

Justification: Construction of artificial barriers around the SSBs will assure maximum odor dispersion during continuous "puff" conditions (wind speeds between 1 and 3 mi per hour) when the near-ground temperature signifies that sufficient temperature inversion exists to create unfavorable nondissipation transport conditions. Barrier mixing will result in significant reductions in odor risk, and these reductions will be greatest in those months in which the highest frequency of "puff" transport conditions occur.[31,33]

10. Each pair of basins should be provided with a wind machine should be of sufficient horsepower (75 to 100 hp) to assure complete agitation of the total surfaces of the contiguous basins. Wind machines should be capable of rotating 360 degrees in slightly less than 5 min.

    Justification: Wind machines will be designed to provide odor dispersion during periods of intermittent "puff" conditions (wind speeds less than 1 mi/hour) when the near-ground temperature signifies that sufficient temperature inversion exists to create nondissipating transport conditions.[28] Under these conditions, wind machines in combination with barriers can effect the much needed initial dispersion of odors and resultant decrease in odor risk. The frequency at which wind machines can be expected to play an important role in increasing initial mixing of odorants parallels that of the frequency of barrier mixing effectiveness.[31,33]

11. Two micrometeorological data acquisition and control system (DACS) units, one currently between SSB 6 and 7 and the other near the pilot odor stripping facilities, should be used to continually monitor the atmospheric sublayer for "puff" transport (PT) conditions. The stations should each consist of a 26-ft (minimum) portable tower constructed of

heavy guage aluminum tubing equipped with a wind speed anemometer, wind direction vane and two aspirated shielded temperature probes capable of being mounted at any point on the tower.[27]

The micrometeorological monitoring station shall be a self-contained and complete unit capable of computing through a microprocessor system and digitally recording the following parameters:

1. Absolute temperature.
2. Temperature differential between two probes.
3. Mean and standard deviation of wind velocity.
4. Mean and standard deviation of wind direction.

The microprocessing system shall be capable of sampling, averaging over time and digitally printing the parameter data at selected time intervals of 5 minutes for wind data and 15 minutes for temperature data. The microprocessing system shall have capacity to manipulate input data so that decisions can be made by the system based on preprogrammed interaction of specific parameter magnitudes.

> Justification: The DACS units will monitor atmospheric conditions and, through the PCC, alarm plant operators to control and modify SSB operations during periods of unfavorable micrometeorological conditions to reduce the likelihood that odors might be generated and/or tranported to residential areas and result in complaints. The key advantage of such units is the elimination of costly manual data interpretation and recording.

12. The single-stage vacuum vaporization process should be used at the Regional Plant to strip odor from the digested sludge prior to discharge to the SSB system. A minimum

applied vacuum of 28 in. Hg and a sludge loading rate of 36 gpm/sq ft of vacuum chamber cross-sectional area should be used. A maximum of net vapor to sludge ratio of 3.15 cfm vapor per cfm sludge should be used as a minimum for design of vacuum pump and air handling facilities. The vacuum chamber design should result in maximum exposure of sludge to the vacuum and maximum detention time. The chamber itself should include a barometric leg. Sludge should be maintained at the highest temperature possible for maximum odor removal. This will require insulation of the digested sludge lines between the in-line blending and storage digester and vacuum vaporizing facilities.

Justification: Field evaluation of the vacuum vaporization process during the SSB source odor control study[11] demonstrated a significant quantity of odor can be removed from digested sludge. The vacuum vaporizer odor stripping process was successful in removing approximately 50 percent of the initial surface odor concentration, resulting in a significant reduction in odor risk.

13. Activated carbon adsorption should be used for control of off-gas odors from the digested sludge odor-stripping process. High surface area, vapor-phase carbon with enhanced capacity for H_2S should be used. A carbon depth of 12 in. was observed to provide satisfactory odorant removal capabilities at surficial velocities from 100 to 150 fpm. The maximum facility size should be based on maximum observed ratio of net vapor produced per volume of sludge treated, and the maximum facility size should be based on maximum total off-gas flow required to prevent vacuum pump cavitation in odorant removal processes. It is expected that the existing odorant removal from the pump building will achieve the H_2S removal required.

Justification: During the SSB source odor control study, carbon was proven to be effective in the control of off-gas odors from the vacuum vaporization process.[11] It is anticipated that using carbon will result in an odor reduction to less than 50 ou/cf.

14. Digested sludge from the Regional Plant should be strained prior to discharge to the SSBs. Strainers should be provided downstream from the vacuum vaporization facilities and be equipped with 1/8-in. mesh rotating screens.

    Justification: Straining of digested sludge will minimize operational difficulties associated with sludge harvesting and make the basin supernatant aesthetically more acceptable.[14] During the source study, it was calculated a total of 0.07 cu ft of strainings per 1,000 gal of digested sludge was removed by the strainer.[7] Material removed as strainings during Regional Plant operation should be incorporated with the dewatered grit disposal system (normally discharged to the incinerator).

15. One additional digester (385,000 cu ft capacity) should be added for Stage I Regional Plant facilities as a storage and blending unit.

    Justification: This additional digester will be used to reduce short-circuiting of sludge through the digesters and provide blending for individual digester discharge prior to feeding the SSBs. The new digester would be operated as a storage unit and would be loaded with digested sludge from all nine complete-mix digesters. Short-circuiting would be minimized due to its 2- to 3-day detention time and complete mixing capabilities. Maximum cover travel will assure ability to discharge to SSBs with maximum independence from loading cycle of individual digesters. It would provide an important mixing operation to dilute high odor potential sludge from some digesters with lower odor potential sludge from others since there is a natural variation in digested sludge from one tank to another.

This recommendation is in conflict with the Second Annual Report on SSB Operation and Performance, where construction of two additional digesters was advocated along with continued use of existing fixed-cover Digesters 1 and 2.[14] The topic has received considerable thought and investigation since February 1977. While this investigation indicates it is not possible to utilize any of the existing, or presently under construction, digesters for this function, it is now considered feasible to accomplish the desired odor reduction through prescribed operation of only one additional large storage and blending unit.[21] Existing fixed-cover Digesters 1 and 2 are not now being considered for this function because of the inherent danger of filling and drawing under fixed covers with the continuing production of methane gas.

16. All-weather gravel roads should be provided around all basins within the barrier system. All-weather gravel roads should be provided from the Regional Plant to all 16-ft wide barrier access gates.

    Justification: These roads are required to assure easy access to, and around, all SSBs during periods of inclement weather.

17. Two 10-hp (demand), 15-hp (design) horizontal, brush-type mechanical surface mixers, with 8-ft rotors and blades arranged in a full helical trim, should be provided for each SSB; one located at the northeast and the other at the southeast corner to take full advantage of the prevailing wind direction. The SSBs, themselves, should be oriented so that the greatest amount of water surface area is exposed to the prevailing wind.

Justification: Orienting the SSBs and surface mixers in this manner will assure that the surface deposits of scum and solids which appear during basin loading accumulate in the basin corners where the mixers can dissipate them.

18. Mixer operation should be designed for remote control to allow the plant staff to automatically control their operation from the PCC or from the ACC No. 8/13 should manual operation become necessary.

Justification: This design consideration will allow control of the mixers from a central location, thereby providing for more convenient operation and more efficient use of personnel. Remote control will allow the operators to quickly terminate mixer operation during periods of unfavorable meteorological conditions.

19. Mechanical surface mixers should be designed for mounting off the basin levee. Units should have three pontoons, metal struts, and an access bridge and platform meeting all OSHA requirements.

Justification: Although this method of securing mixers is more expensive than alternate methods (see Appendix B) using cables, it will more than pay for itself over time because of reduced maintenance costs. Weekly maintenance can take place without the need for launching a boat or relocating equipment.

20. All mixer mechanical equipment, including the blades of the surface mixers should be coated with a very smooth impervious surface, such as fusion epoxy.

Justification: Providing a smooth surface will minimize struvite (magnesium ammonium phosphate) buildup on this equipment which results from routine operation.

21. Supernatant drawoff points (one per SSB) should have some depth flexibility but need not extend to the bottom of the basin.

Justification: A properly positioned supernatant drawoff point will provide for proper operation of the in-basin supernatant storage system but will not be low enough where drawoff of sludge would be possible. Excessive dewatering, if required, would be accomplished by dredging.

22. The SSB supernatant return system should be composed of plastic piping and designed for gravity flow and to eliminate free-falls and critical-depth flow conditions.

Justification: Elimination of free-falls and critical-depth flow conditions will minimize the conditions which are conducive to the crystalization of struvite from the supernatant onto the piping. The smooth surface of plastic piping will also minimize this crystalline buildup.

23. SSB supernatant piping should be separate from DLD and landfill storm runoff piping upstream of the flow control and metering structure. All pipeline material should be PVC.

Justification: Separate SSB supernatant and DLD and landfill drainage piping is necessary to assure the accurate determination of the individual flow stream quantity and quality prior to its return to the Regional Plant via the city interceptor sewer and provide the supernatant flow control required to divorce its continuous return flow from the effect of the periodic digested sludge supply flow. The use of PVC for pipelines will assure minimum problems with struvite crystalline buildups.

24. SSB supernatant pipelines should anticipate ultimate (1999) development by including sufficient capacity, future extensions and manholes and future layouts. This should

include, if necessary, the installation of oversize piping, future extensions in existing levees and lower inverts to assure maximum service area.

Justification: The cost and operational impact of the construction of future SSBs on the existing SSBs must be considered at this time. In many cases, proper planning now will be able to assure maximum utilization of existing facilities for the entire life of the project.

Operation

1. SSBs should be filled to normal operational level with plant effluent and given sufficient time (3 to 6 weeks) to develop an aerobic surface layer prior to digested sludge addition.

   Justification: The development of an aerobic surface layer prior to digested sludge additions is an important operational consideration. The successful trouble-free start-up of SSBs 5 and 6 during the summer of 1976 using this procedure attests to the validity of this statement.[13]

2. The SSB design loading rate should be 20 lb VS/1,000 sq ft/day, based on annual digested sludge production.

   Justification: Several of the SSBs have been continually fed at the design loading rate of the past 3 years. This loading rate has proven to be a safe loading rate and one that can be used confidently during all seasons of the year. Previous operation of the full-size basins has shown that loading rates of 40 lb VS/1,000 sq ft/day can be used for a period of 2 to 3 months during the seasonal waste loading and the summer sludge harvesting periods.[14] Results from the SSB experimental studies indicated that SSBs can accept loading rates as high as 90 lb VS/ 1,000 sq ft/day for a period of 1 week during the summer without upset.[7]

3. SSBs should be loaded on a daily basis.

   Justification: Controlled loading on a daily basis provides for most efficient SSB operation.[14] Daily loading does not place an undo stress on the basins and allows the surface mixers to easily dissipate the surface scum and solids, which tend to accumulate during loading. Although contradictory, routine operation has indicated, however, that SSBs can function efficiently when loaded as infrequently as once every 4 days. Digested sludge supply system design should anticipate loading on a daily basis, however.

4. Shock loadings, such as digester cleanings or excess WAS, should be distributed to operational SSBs in relation to the quantity of buffer they possess.

   Justification: Buffer may be defined as the amount of digested sludge previously added to an SSB or the quantity of stored sludge a basin contains. Although no WAS was added to the SSBs in 1978, prior experience has shown that the basins can effectively assimilate raw sludge for short periods of time without upset. During Experiment 5 of the SSB experimental studies, calculations were made which indicated that the east pilot SSB being fed raw WAS had failed after its calculated buffering capacity was exceeded.[7]

5. SSBs should be loaded during periods of favorable micrometeorological conditions (best vertical mixing), generally between 1 to 2 hours after sunrise and 1 to 2 hours before sunset) and also during the period of minimum human sensory

perception (midnight to 5:00 a.m.). This latter period should be used whenever it is necessary to increase the allowable number of hours each day that the basins can be loaded.

Justification: Loading during favorable vertical mixing conditions will assure any odors generated from loading will be adequately dispersed and not transported to plant boundaries in concentrations which will be detected by local residents. Loading also during the period of minimum human sensory perception will increase the number of hours each day that future SSBs can be loaded. In so doing, the necessity of providing more than three digested sludge supply pumps can be avoided. Because the actual number of hours of good vertical mixing conditions will vary each day, atmospheric monitoring equipment should be relied upon to notify operators when not to feed basins or operate mixers and when to run the wind machines.

6. The 15-hp (design) mechanical surface mixers should be operated on a daily basis for a period of 12 hours (6:00 p.m. to 6:00 a.m.).

   Justification: Results from the 1978 SSB mixer study (Appendix B of this report) indicated that this amount of mixer operation will provide the needed agitation for control of surface scum and solids accumulations. On-going studies will determine if 6 hours/day of mixer operation will be adequate to assure successful SSB operation.

   It is very likely that operation of the mixers will coincide with the feeding of some basins, especially with 12 hours/day mixer operation. However, increased odor emissions during the period of minimum human sensory perception (midnight to 5:00 a.m.) should not be detected by local residents. Remote control should be provided for both mixers and basin feed valves will assure that the operator at the digester control complex will be able to shut down basin mixers during basin feeding if necessary. This will aid in reducing potential nuisance odors.

7. Atmospheric monitoring equipment already installed at the site of the existing SSBs should be used in daily basin operations to notify operators when not to feed basins or operate mixers and when to run the wind machines. This equipment will have to be modified to include wind direction diffusivity and wind speed for operation of future SSBs.

   Justification: This equipment will monitor atmospheric conditions and will be used by plant operators to control and modify SSB operations during periods of unfavorable meteorological conditions to reduce the likelihood that odors might be generated and/or transported to residential areas and result in complaints.

8. SSB supernatant levels should be lowered 14 in. maximum during the late summers of those very dry years when it can be projected that the flow of the Sacramento River in the fall would drop below 8,000 cfs.

   Justification: Manipulating the supernatant level in this manner will assure the elimination of recycle to the plant during that time of year when recycle would result in the plant effluent depressing DO levels in the Sacramento River to below receiving water discharge requirements.

   This recommendation is in conflict with recommendations for supernatant control contained in the Second Annual Report on SSB Operation and Performance.[14] In that report, it was recommended that (1) supernatant return to the plant headworks should be avoided, (2) a large supernatant storage pond be constructed, and (3) the supernatant in all basins should be maintained at normal operation levels at all times. As a way of reducing costs and possible odors, it was concluded during the preparation of the SSMP Draft EIR that manipulation of the SSB supernatant levels during the summer would make it possible to avoid construction of a large supernatant storage pond and would also minimize supernatant recycle to the plant headworks.[21] This manipulation will only be required during those years when weather conditions indicate river flows will drop below critical levels. It is anticipated these conditions will be predictable at least 6 months in advance.

9. Regional Plant recycled supernatant flows and quality should be monitored prior to discharge to the inflow of the plant via the City Main interceptor. Supernatant flow control system should normally be operated to maintain a continuous 24-hour return flow with the flow rate varied in proportion to the diurnal variation of the Regional Plant influent flow.

   Justification: Accounting for the recycle loadings in this manner will allow a determination of overall plant performance to be made during periods of supernatant recycle.

10. SSBs which are to be harvested should be removed from active status at least 30 days prior to removal of any sludge.

   Justification: Removal of the SSB from active status will allow for added stabilization prior to transfer to the DLD sites. If some form of reuse is contemplated in the future, the inactive status should be increased sufficiently to be in conformance with state and federal regulations. At the present time, regulations indicate that a 120-day period of inactivity would be sufficient to satisfy the most stringent of these requirements. With Stage I facilities in operation, it is assumed that four basins will be harvested each year and will be taken out of service for a 120-day period. The basins should be scattered, rather than harvested as a block of SSBs so that the loading on the DLD sites can be evenly distributed.

11. Harvesting operations should be limited to those SSBs which, when inventoried, indicate sufficient depth of consolidated sludge to assure maximum solids content (at least 6 to 8 percent solids) in the harvested sludge.

    Justification: An adequate supply of properly consolidated sludge is essential to minimize harvesting costs and provide for most efficient operation. A solids concentration of 5 to 6 percent was previously recommended[14] but the addition of a new type of dredge, with the capability for pumping greater solids concentration, justifies increasing these solids' values.

12. During sludge harvesting operations, the SSB water level should not be lowered more than 14 in. below the normal operational level of 114 ft. In no case should the water level be allowed to drop low enough to expose the sludge blanket.

    Justification: Maintaining the SSB supernatant at reasonable levels will assure the maintenance of an adequate aerobic surface layer and that odors are not produced as a result of exposing large areas of sludge to the atmosphere.

13. No basin should be allowed to accumulate sludge concentrations sufficient to cause sludge blanket formations within 2 ft of the minimum operating water surface elevation.

Quarterly SSB solids profiles will provide a means of continually assessing sludge buildup with the basins and harvesting operations should be regulated to assure sludge accumulations do not exceed this important operating restriction.

Justification: Maintaining a minimum operating water surface elevation of 2 ft will assure an adequate aerobic surface layer on the basins for odor control. An adequate surface layer will allow the surface mixers to operate effectively.

SSB Monitoring Program

The recommended monitoring program for the SSBs is basically a data collection and analysis function aimed at determining if permit conditions, operational constraints, regulatory constraints and design objectives are being met and to determine if the harvested sludge chemical content would be compatible with future reuse options. Listed in Table B-1 is the recommended monitoring schedule, some of which is duplicative of monitoring that has routinely been conducted by Central plant staff. Future SSBs should be surrounded by groundwater monitoring wells. Groups of four basins should have four wells located around their periphery, and groups of eight SSBs should have eight test wells.

Table B-1. Recommended SSB Monitoring Program

Sample type	Sampling frequency	Constituents
Raw and thickened sludge (to digesters)	Daily	Flow, TS, VS
Digested sludge (from digesters)	Daily	Flow, TS, VS
SSB stored sludge	Quarterly profiles	TS, VS
SSB supernatant (each basin)	Every two days	pH, temperature, H_2S, DO
Recycled supernatant (total of all basins)	Daily	TKN, NH_3-N, PO_4-P, COD, BOD, SS, pH
Harvested sludge	2/basin/yr (8 total)	Alkalinity, Cl, NH_3, soluble P, SO_4, TP, TN, Ca, Mg, K, Na, As, Be, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Se, Ag, Zn, PCB 1254, Technical chlordane, DDE, TS, VS, pH, EC, PCB 1242.
SSB groundwater	Quarterly	Alkalinity (phenolphthalein and methyl orange), Cl, TPO_4, hardness (Ca and Mg), pH, TKN, NH_3-N, NO_2-N, organic -N, COD, pH, EC.

APPENDIX C

RECOMMENDATIONS FOR DLD DESIGN AND OPERATION

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RECOMMENDATIONS FOR DLD DESIGN AND OPERATION

Disposal of sludge harvested from SSBs will be on dedicated land disposal (DLD) sites located as close as possible to the SSBs. For this alternative analysis, it is assumed that harvested sludge will be injected into the top four- to six inches of soil through a crawler tractor-mounted subsurface injection unit. Sludge disposal from the 20 SSBs will be accomplished with two dredges and four injectors.[42]

The disposal area should be divided into five DLD sites with a net area available for injection of 185 acres. Each DLD site should be approximately 1,300 feet wide by 1,600 feet long. Each field would be diked and graded such that all site runoff is contained in each DLD site. When sufficient runoff has accumulated on the DLD site it would be drained through the SSB supernatant system to the SRWTP headworks. The following paragraphs present the detailed design criteria for the several components of the DLD system.

Dedicated Land Disposal Site Layouts

1. Each dedicated land disposal site layout should have a gross area of 48 acres. it is expected this will result in a usable area of 37 acres (185 acres for 5 sites).

2. Each site should be approximately 1,300 feet wide. This dimension is determined by the 660-foot length of the subsurface injector feed hose and the turnaround space required at each side of the field.

3. Each site should be approximately 1,600 feet in length. This dimension is determined by the area required to allow two injectors to operate continuously (six hours/day, five days/week) during the peak dry months of June, July, and August. Peak dry month operation assumes one pass is made over the DLD site each week by two injectors. During other harvesting months (May, September, and October), it is assumed maximum operation will be limited to one injector making one pass every two weeks on each 37-acre DLD site.

4. Each DLD site should be graded such that all surface runoff would drain to one point near the edge or in the corner of the field. The low drain point should be provided with a reinforced concrete apron surrounding a center drain. The center drain should be connected by gravity into the nearest manhole on the SSB supernatant system. The center drain should be equipped with variable height overflow weirs. The highest weir should extend the drain overflow to elevation 116.0 to provide positive backflow protection when the SSB supernatant system is operating in its summer equalization mode.

5. Each DLD site should be surrounded by an isolation berm designed to keep uncontaminated surface runoff out and contaminated DLD site runoff in. The berm should be 15 feet wide at the top and should be provided with 3:1 side slopes. The top of the berm should be finished with an all-weather gravel road.

6. Each DLD site should be provided with an all-weather gravel access road to assure light truck access at all times to its isolation berm system

7. Dedicated channel communication radios should be installed in the injectors, dredges and supervisor's vehicles. Citizen band radios have been used in pilot tests but they

are not reliable enough for emergency communications neccessary when, for example, a tractor breakdown occurs or an injector feed hose breaks.

Harvested Sludge Piping

1. SSB layout-SSB harvested sludge piping should be located in the levees between the SSBs and arranged so that two dredges can be operated in and two of a group of four basins simultaneously. Dual piping should be valved to allow supernatant used for purging sludge piping to be returned to a basin within the group of four from which it came.

2. DLD Layout - DLD harvested sludge piping should be arranged so that two injectors will be able to operate from separate dredges on the same DLD site at the same time. Dual piping should be valved to allow supernatant used for purging sludge from distribution piping, not including field hydrants, to be returned to an SSB within the group of four from which it came.

3. Injector Feed - Each DLD site should be provided with six field hydrants for injector feed connection. Field hydrants should bisect the length of the field and be located approximately 260 feet apart. Each field hydrant should have a foul-proof pressure-sensing device, a manual isolation valve, and a swivel-elbow assembly designed for quick coupling to a 4 1/2 inch injector feed hose.

4. Main Distribution System - Individual groups of four SSBs and individual DLD sites should be interconnected by a dual-main distribution system designed to allow each group of four SSBs to feed harvested sludge to at least two DLD sites. For the purposes of meeting this requirement, it is assumed each group of four SSBs would feed the nearest two DLDs.

Dedicated Land Disposal System Operation Criteria

1. DLD sites should be loaded at 100 tons/acre (dry weight) of harvested sludge per year.

2. All DLD sites should be equally loaded each year.

3. DLD sites should be disked as required to assure all sludge is covered daily. Disking will also promote drying and minimize odor production.

4. Harvested sludge piping should be flushed and purged with SSB supernatant at the end of each day's run. Sludge purged from piping should be injected into the disposal site until replaced by supernatant. When starting each day's operation, supernatant within harvested sludge piping should be purged as much as possible back to the SSB basins from which it came.

5. Monitoring should be in compliance with Regional Board waste discharge requirements.

6. DLD surface soil pH must be maintained at pH 6.5 or higher. It is estimated that one ton/acre/year of lime will have to be applied for pH control.

REVISED WORK PLAN AND PROPOSAL

SEWAGE SLUDGE MANAGEMENT PROGRAM

Job J222 February 17, 1976

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

February 17, 1976 J222A

Mr. Brian H. Richter
District Engineer
Sacramento Regional County
Sanitation District
827 Seventh Street
Sacramento, California 95814

REVISED WORK PLAN AND PROPOSAL FOR
SEWAGE SLUDGE MANAGEMENT PROGRAM

After the October 6, 1975, submittal of the original work plan and proposal for the District's wastewater solids management program, discussions with the District indicated the need to eliminate the agricultural utilization aspect of the sludge program and substitute a plan for dedicated land disposal. Your staff's concerns with the reclamation phase of the program dealt primarily with the large expenditure of funds for the agricultural use demonstrations ($1.641 million of the $2.227 million original program costs) when (1) the District has no assurance that regulatory controls would not prevent such use; (2) the District could not determine how much of the work within the scope of the demonstrations would be considered a duplication of efforts already being funded by the State Water Resources Control Board in Southern California and the San Francisco Bay Area; (3) the District could not guarantee that sewage sludge reclamation on nearby farms would be accepted by the agricultural community; and (4) the limitations on reclamation indicated by the demonstrations might require the District to acquire and manage large land areas, and this might prove to be politically unacceptable. We concur with these concerns and agreed to revise the work plan and proposal accordingly.

Although the 1975 Solids Study did not include dedicated land disposal, both Federal and State regulatory agencies have recently indicated increasing awareness and acceptance of this method of disposal. This dedicated land concept acceptance, when coupled with the continuing delay in the establishment of regulations for heavy metals, nutrients, and chlorinated hydrocarbons in reclaimed sludge and the increasing need for development of a cost-effective, minimum energy use, and environmentally safe sludge disposal system for the regional plant, makes it imperative that the sludge management program be started immediately.

A revised work plan and proposal for this program includes six tasks: (1) program management; (2) regulatory agency coordination; (3) source survey - phase I; (4) solids storage basin studies; (5) dedicated land disposal study; and (6) miscellaneous use determinations. This program is required to assure that the method of final disposal complies with all proposed Federal, State and local regulations; therefore, this work is considered to be a necessary part of design of the sludge disposal program.

The work involved in this program includes all of the previously outlined six tasks. For purposes of clarity and organization each task is treated as a subauthorization and documented accordingly. Total cost for the 46-month program is estimated at $1,422,000. Cost changes from the original work plan and proposal include a $1,043,000 reduction in substituting the dedicated land disposal study for the agricultural use demonstrations, a $189,000 increase in the SSB studies for more extensive odor and site engineering work, a $85,000 increase in Miscellaneous Use Demonstrations for the addition of a virus study, and minor changes to other tasks for extra work on proposals, additional groundwater investigations and elimination of the public relations program. Individual cost details for each task are listed under each subauthorization. The enclosed Sewage Sludge Management Program - Schedule and Costs provides a timetable and cost for each subtask and the complete program cost breakdown by fiscal year.

We believe this program now fully reflects the concerns of your staff and the immediate needs for implementation of the Regional Wastewater Management Program. We recommend that it be presented to the State Water Resources Control Board staff for review and approval as soon as possible.

SACRAMENTO AREA CONSULTANTS

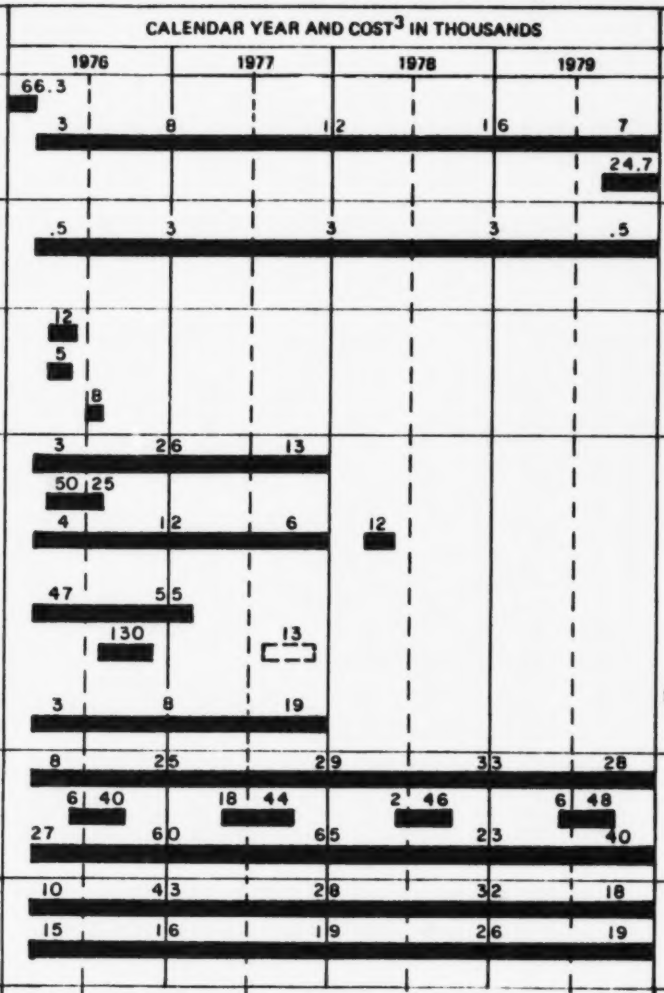
Lyle N. Hoag

Lyle N. Hoag
General Manager

LNH:WRU:lb

Encl.

SEWAGE SLUDGE MANAGEMENT PROGRAM - SCHEDULE AND COSTS



TASKS	SUBTASKS	FISCAL YEARS AND COST^3 IN THOUSANDS					TOTAL COSTS^3, \$1000	
		1975-76	1976-77	1977-78	1978-79	1979-80	SUBTASKS	TASKS
1 PROGRAM MANAGEMENT	AUTHORIZATION PREPARATION - 1975 STUDIES	66.3					66.3	137.0
	MANAGEMENT 1976–1979 STUDIES	3	8	12	16	7	46.0	
	REPORT PREPARATION					24.7	24.7	
2 REGULATORY AGENCY COORDINATION	LIAISON AND SPECIAL REPORTS	.5	3	3	3	.5	10.0	10.0
3 SOURCE SURVEY PHASE I	RAW SLUDGE STUDIES	12					12.0	25.0
	INFLUENT-EFFLUENT STUDIES	5					5.0	
	PREPARATION OF PROGRESS REPORT		8				8.0	
4 SOLIDS STORAGE BASIN STUDIES	CONT. OPERATION AND PERFORM EVALUATION^1	3	26	13			42.0	426.0
	SSB EXPERIMENTAL WORK	50	25				75.0	
	CONT. GROUNDWATER MONITORING AND SITE ENGINEERING WORK	4	12	6 12			34.0	
	CONT. DIURNAL ODOR MONITORING						J215	
	SOURCE ODOR CONTROL STUDY	47	55				102.0	
	DEVELOPMENT ODOR CRITERIA FOR LARGE EMISSION AREAS^2		130	13			143.0	
	FEASIBILITY OF COVERING SSB's						SUBTASK 1.1	
	MANAGEMENT AND REPORT PREPARATION	3	8	19			30.0	
5 DEDICATED LAND DISPOSAL STUDY	MANAGEMENT AND REPORT PREPARATION	8	25	29	33	28	123.0	598.0
	SITE DEVELOPMENT AND SLUDGE SPREADING	6	40 18	44 2	46 6	48	210.0	
	SLUDGE AND DISPOSAL SITE MONITORING	27	60	65	23	40	265.0	
6 MISCELLANEOUS USE DETERMINATION	MICROBIOLOGICAL STUDY	10	43	28	32	18	131.0	226.0
	VIRUS STUDY	15	16	19	26	19	95.0	
TOTAL FISCAL YEAR COSTS^3, \$1000		259.8	477.0	265.0	235.0	185.2	1,422	
							TOTAL PROGRAM COSTS^3 \$1000	

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[1] COSTS ARE IN ADDITION TO THOSE REQUIRED FOR NORMAL PLANT OPERATION

[2] IF STUDY DELAYED UNTIL 1977 – EXTRA INFLATION COSTS \$13,000

[3] ALL COSTS REFLECT TIME PERIOD INVOLVED – INFLATION ASSUMED 10% PER YEAR

OUTLINE OF CONTENTS

Introduction

Job No. (Subaccount)	Task No. and Title	Cost
J222A	Task 1 - Program Management	$ 137,000
	Subtask 1.1 - Authorization Preparation and 1975 Studies	$ 66,300
	Subtask 1.2 - 1976-1979 Studies	$ 46,000
	Subtask 1.3 - Final Report Preparation	$ 24,700
J222B	Task 2 - Regulatory Agency Coordination	$ 10,000
	Subtask 2.1 - Liaison and Special Reports	$ 10,000
J222C	Task 3 - Source Survey - Phase I	$ 25,000
	Subtask 3.1 - Raw Sludge Studies	$ 12,000
	Subtask 3.2 - Influent-Effluent Studies	$ 5,000
	Subtask 3.3 - Preparation of Progress Report	$ 8,000
J222D	Task 4 - Solids Storage Basin (SSB) Studies	$ 426,000
	Subtask 4.1 - Continuing Solids Storage Basin Operation and Performance Evaluation Program	$ 42,000
	Subtask 4.2 - Solids Storage Basin Experimental Work	$ 75,000
	Subtask 4.3 - Continuing SSB Groundwater Monitoring Program and Site Engineering Work	$ 34,000
	Subtask 4.4 - Continuing Solids Storage Basin Diurnal Odor Monitoring Program	incl. in J215
	Subtask 4.5 - Solids Storage Basin Source Odor Control Study	$ 102,000
	Subtask 4.6 - Development of Odor Criteria for Large Emission Areas	$ 143,000
	Subtask 4.7 - Feasibility Study of Covering Existing Solids Storage Basins	incl. in 1.1
	Subtask 4.8 - Solids Storage Basin Study Management, Data Reduction and Report	$ 30,000
J222E	Task 5 - Dedicated Land Disposal Study	$ 598,000
	Subtask 5.1 - Management and Report	$ 123,000
	Subtask 5.2 - Site Development and Sludge Spreading	$ 210,000
	Subtask 5.3 - Sludge and Disposal Site Monitoring	$ 265,000

Job No. (Subaccount)	Task No. and Title	Cost
J222F	Task 6 - Miscellaneous Use Determinations	$ 226,000
	Subtask 6.1 - Microbiological Study	$ 131,000
	Subtask 6.2 - Virus Study	$ 95,000
J222	SRWMP Sewage Sludge Management Program Total Cost	$1,422,000
Appendix A	Proposal of EUTEK for Odor Control by Stripping Digested Sludge Feed	
Appendix B	Proposal of EUTEK for Evaluation of the Effect of Large Scale Source Odor Emissions on Downwind Odor Concentrations	

INTRODUCTION

The 1975 Solids Study recommended that the Sacramento Regional Wastewater Treatment Plant sewage sludge processing and disposal system consist of 20-30 day anaerobic digestion for stabilization, faculative solids storage basins (SSBs) for storage and agricultural reclamation for disposal. Prior to the purchase of the thousands of acres required for agricultural reclamation, it was recommended that a four to five year Sewage Sludge Management Program (SSMP) be undertaken to ascertain, within Federal and State regulatory limitations, just what methods of agricultural reclamation would be most acceptable and what limitations must be applied to the SSBs to assure their operation within necessary environmental restrictions.

Unfortunately Federal and State regulatory guidelines and standards for sludge agricultural reclamation have still not progressed beyond the preliminary stage. Under these circumstances no guarantee could be made that any program would provide acceptable results, therefore it was impossible for the District to accept the high cost for agricultural reclamation experimentation. Indeed the increasing awareness of apparent risks within sludge reclamation seem to be decreasing rather than increasing the feasibility of developing an economical system of reuse. For these reasons the District requested the substitution of dedicated land disposal for the agricultural reclamation phase of the recommended sludge processing and disposal system.

The SSMP now involves six tasks: (1) program management; (2) regulatory agency coordination; (3) source survey-phase I; (4) solids storage basin studies; (5) dedicated land disposal study; and (6) miscellaneous use determinations. Each task is designed to provide the type of data required to assure that the method of sludge processing, storage and disposal will comply with all of the proposed Federal, State and local regulatory guidelines and standards and assure that the solids from the new regional treatment plant will be disposed of in the most cost-effective manner.

One of the three major thrusts of the SSMP is to assure that the SSBs can be operated to everyone's satisfaction under all types of conditions. These deep earthen basins are intended to operate with a surface aerobic algal growth which has been found to reduce odors, limit solids recycle and maintain maximum oxygen transfer conditions. Over $400,000 in investigations and studies are to be undertakenover the next two years to prove the feasibility of SSB operation without odor nuisances.

The second major thrust of the SSMP is to ascertain the practical limits of the application of liquid stabilized sludge (5% solids) to dedicate land in the vicinity of the new regional treatment plant. These practical limits are to be established well within the environmental constraints required by the regulatory agencies. Almost $600,000 is to be spent in the next four years to determine the most environmentally safe, cost-effective means of applying sludge to land dedicated in perpetuity for this purpose.

The third major thrust of the SSMP involves the documentation of the effect of anaerobic digestion, long term SSB storage and dedicated land disposal on the survival of pathogens and other specific organisms and of virus. Most textbooks claim minimum survival for these health hazard vectors, however very little documentation is available, especially on similar sludge processing and disposal systems which maximize natural biological degradation and solar utilization. Slightly more than $225,000 will be spent over the next four years to assure adequate knowledge on this important aspect of sewage sludge disposal.

Other phases of the SSMP are designed to assure that all studys are properly managed and reported and that the issues of source control and regulatory agency coordination are given the attention they require. The complete four year program is estimated to cost $1,422,000, will involve four years of study and will result in the preparation of two final reports; i.e., SSB Studies in 1978 and Dedicated Land Disposal Studies in 1980.

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 1 - PROGRAM MANAGEMENT

Program management involves the following three subtasks: (1) authorization preparation and all preparatory work done on other sub-authorizations prior to formal acceptance of sewage sludge management program; (2) management of the entire four-year sludge studies including the maintenance of monthly status reports, quarterly progress reports and annual interim reports; and (3) preparation of final recommendation and documentation report. Work shall be as described in the following detail descriptions of work.

Final recommendations and documentation report will set forth the Sacramento Regional Wastewater Management Program (SRWMP) sewage sludge dedicated land disposal program for the next twenty years.

DETAIL DESCRIPTION OF WORK - SUBTASK 1.1 - PROGRAM MANAGEMENT AUTHORIZATION PREPARATION AND 1975 STUDIES

Upon receipt of verbal instructions from Messers Hyde and Richter in the fall of 1975 to proceed with the planning and coordination of the SRWMP Sewage Sludge Management Program (Sludge Management Program) SAC immediately started to develop detail description of work and job authorizations for all related work in accordance with the recommendations of the 1975 Solids Study. Development of these plans entailed extensive conferences with outside consultants and Dr. Burau of the University of California at Davis. The result of this work was the preparation of individual proposals for the accomplishment of the field and laboratory work involved in the agricultural use demonstrations and the microbiological work involved in the miscellaneous use determinations. The material along with other detail descriptions of the other four tasks of the sewage sludge management program were submitted to the District on October 6, 1975.

Subsequent meetings, discussions and analysis have indicated that at this time sufficient unknowns exist to make it unwise to proceed with the development of extensive agricultural use demonstrations as a part of the District's sewage sludge management program. As a result of this finding, the District has authorized SAC to proceed immediately to revise and update the program's work plans and proposals to eliminate the agricultural use demonstrations and include a dedicated land disposal and virus survival study.

Subauthorizations are again to be formulated for each of the six tasks of the Sludge Management Program. These subauthorizations will include documentation of detail description of work for each individual subtask. These descriptions are to include program element information, time schedules and individual cost breakdowns.

Much of the work of the Sludge Management Program involves tasks which are dependent on seasonal variations of the sewage and the climate. Both dependents have already required several of the parts of the program to get underway. These include such items as the maintenance of the continuity of the solids storage basin (SSB) operation and performance evaluation program, the investigation of liquid solids application techniques, SSB diurnal odor studies, and the construction of pilot test basins for the SSB odor stripping study. In addition, the need for a design feasibility study relative to the possible covering of some of the SSBs was considered urgent because of the limited period of time remaining prior to issuance of regional plant contract documents. For the purposes of fiscal clarity the costs for these services, unless otherwise indicated, including all SAC management of same, are incorporated into this subtask.

For the purposes of the development of this description it has been concluded that all work covered for this subtask will be completed by March 1, 1976. The preliminary draft of all authorizations should be submitted to the District by February 1, 1976. Costs analysis for the earlier work on this subtask indicates that approximately $5000 was spent in coordinating the development of outside consultant proposals and an additional $5000 in formulation of the job authorizations and related material. It is expected that another $3000 will be spent in coordination and another $5,000 in formulation of new job authorizations prior to February 1st.

Prior to November 15, 1975, outside consultant services totalled approximately $14,000 and SAC management costs for these services and the preliminary utilization studies was approximately $11,000. Outside consultant services included about $1,300 of UCD work on soil sampling for the 1976 test tracts. Outside consultant services between November 15th and March 1 , 1976, are expected to be less than $1,000. However, SAC management costs for the outside services are expected to cost $2,500.

Outside laboratory analysis work up to November 15 totalled $8,500. It is expected to cost an additional $2,500 for outside laboratory work between November 5th and March 1st. This includes SSB microbiological examinations ground water monitoring and existing solids processing and handling determinations carried on since the March 1975 cut-off date for charging this work to the 1975 Solids Study. Analysis of monthly Morrison Creek water quality samples taken since the summer of 1975 are expected to cost an additional $9,800.

The total estimated costs for subtask 1.1 is $66,300.

SAC coordination of development outside consultant's proposals			
Prior to November 15, 1975	$ 5,000		
November 15, 1975 - March 1, 1976	3,000		
SAC preparation of job authorizations and related material			
Prior to November 15, 1975	$ 5,000		
November 15, 1975 - March 1, 1976	5,000		
Total SAC development of detail descriptions of work		$18,000	
Outside consultant services			
Prior to November 15, 1975	$13,200		
November 15, 1975 - March 1, 1976	800		
SAC management cost for outside consultant services			
Prior to November 15, 1976	$11,000		
November 15, 1975 - March 1, 1976	2,500		
Total outside consultant services		$27,500	
Laboratory analysis work			
SSB microbiological examinations, solids determination and ground water monitoring			
Prior to November 15, 1975	$ 8,500		
November 15, 1975 - March 1, 1976	2,500		
Morrison Creek water quality monitoring			
Spring 1975 - November 15, 1975	$ 5,800		
November 15, 1975 - March 1, 1976	4,000		
Total laboratory analysis work		$20,800	
Total costs Subtask 1.1			$66,300

DETAIL DESCRIPTION OF WORK - SUBTASK 1.2 - PROGRAM MANAGEMENT
1976 - 1979 STUDIES

The SRWMP 1975 Solids Study recommended the immediate activation of a comprehensive sewage sludge management program (Sludge Management Program) designed to assure the validity of the recommended SRWTP sludge processing and disposal system. The present recommended Sludge Management Program includes six tasks: (1) Program Management; (2) Regulatory Relations; (3) Source Survey - Phase I; (4) Solids Storage Basin Studies; (5) Dedicated Land Disposal Study; and (6) Miscellaneous Use Determinations. The work of this subtask involves task (1) Program Management.

It is expected that the five other tasks of the proposed Sludge Management Program will involve personnel from the design and the maintenance and operations sections of the County's Water Quality Control Division and special consultants on sludge management, sludge spreading and microbiological and virus considerations. To assure proper coordination and expedition of the work involved and adequate documentation of the data collected the entire sludge management program is to be managed by SAC.

Such management will include the preparation and enforcement of program milestones and scheduling the preparation of monthly status statements, the formulation of quarterly progress reports, the compilation of interim annual reports and the supervision of the work of others involved in the five tasks.

Although some work has already started on portions of all the tasks the major effort will not start until March 1976. Once underway it is expected to continue through December 1979. However it is expected that most of the field observations and data collecting and analysis should be complete by October 1979.

Management costs for this approximate 4 year period are expected to average about $1000/month (including allowances for inflation), for a total cost of $46,000. Management costs assume that each of the five remaining tasks includes allowances for its own management and that overall program management will not be required to supervise any individual subtasks.

DETAIL DESCRIPTION OF WORK - SUBTASK 1.3 - PROGRAM MANAGEMENT
FINAL REPORT PREPARATION

The SRWMP 1975 Solids Study requires disposal parameters to be developed by a comprehensive sewage sludge management program prior to purchase by the District of any land for disposal purposes. Parameters for such items as loading rates (tons/acre/year) and environment protection (groundwater, surface runoff, soil build-up) must be studied in sufficient detail to satisfy the concerns of the Federal, State and local regulatory agencies. These concerns are presently being expressed in Federal and State proposed guidelines and preliminary drafts of future regulations.

Once the field observations and data collecting and analysis is complete it will be necessary to compile the results and determine their effect on disposal parameters. Final report preparation includes the formulation of these determinations and the development of complete disposal recommendations.

The present Sludge Management Program schedule indicates that the field observations and data collecting and analysis will be complete in October 1979. It is expected that the final report will, therefore be available on January 1, 1980. The 1975 Solids Study Solids Staging Program calls for the first major quantity of solids to be disposed of in the summer of 1981. This provides the District with 18 months of time to finalize their response to the program's recommendations, purchase whatever additional land which is required, and prepare whatever facilities are needed. While this period may be somewhat short, it is possible that the year of first major disposal could be delayed for one or two years by increasing storage levels in the SSBs. Such a delay, however, would probably mean that the annual quantity of sludge to be disposed of, once disposal is started, would increase and that the initial application rates would be greater than the average assumed.

Final report preparation and publication is expected to cost $24,700 (including inflation allowances).

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 2 - REGULATORY AGENCY COORDINATION

Regulatory agency coordination involves keeping current with federal, state, regional and county agency proposed and adopted regulations and assuring that such agencies are kept fully informed of the purposes and findings of the sludge management program. Work shall be as described in the following detail descriptions of work.

DETAIL DESCRIPTION OF WORK - SUBTASK 2.1 - REGULATORY AGENCY COORDINATION - LIAISON AND SPECIAL REPORTS

If the experience of the past two years may be taken as reasonable examples of regulatory agency involvement regarding the ultimate disposal of sewage sludge, the next several years could involve more indecision, more different agencies and more requirements for liaison and special reports. Although the system of monthly, quarterly, annual and final reporting planned for all phases of the sludge management program should be sufficient for most regulatory agency needs, it certainly is not beyond reason to expect that additional data and information will be requested by these agencies as the District works to maintain their approval.

Subtask work would include attendance at agency briefings on new regulations, preparation of responses to proposed regulations, attendance at regulatory sponsored sewage sludge disposal seminars and the preparation of special material to support District applications for agency permits or approvals. All work would require separate individual authorization from the District's manager of the sewage sludge disposal program.

Work under this subtask would be expected to fulfill the special needs for regulatory agency support of ongoing sludge management program. To accurately estimate these needs two to four years in advance is impossible, therefore the cost for this work has been estimated at a nominal $10,000 with the full expectation that it may be exceeded if major regulatory agency concerns develop. No work would be done beyond this nominal cost without a supplemental authorization. The subtask would be accomplished over the complete four-year life of the sludge management program.

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 3 - SOURCE SURVEY - PHASE I

Source survey - Phase I involves the following three subtasks: (1) Raw sludge studies - collection and analysis for heavy metals and chlorinated hydrocarbons of five weekly composite samples of raw sludge from 10 existing wastewater treatment plants; (2) Influent-effluent studies - collection and analysis for heavy metals and chlorinated hydrocarbons of five weekly composite samples of influent and effluent from City Main and Central wastewater treatment plants; (3) Step 1 report preparation - preparation of a progress report providing recommendations regarding need for further source control survey work. Work shall be as described in the following detail descriptions of work.

DETAIL DESCRIPTION OF WORK - SUBTASK 3.1 - SOURCE SURVEY - PHASE I RAW SLUDGE STUDIES

Heavy metals and persistent organics are recognized by regulatory agencies as two of the major deterrents to the successful disposal of sewage sludge. They are also probably the most easily traced and therefore subject to practical source detection and elimination. The 1975 Solids Study realized the necessity to determine, as quickly as possible, if some relatively economical means of source control could affect the present levels of heavy metals and persistent organics in the existing systems.

The most logical, efficient and rapid means of detection of unusually high levels of these toxic materials in various areas of the system is to examine the raw primary and secondary sludge of the existing treatment plants. It is believed the concentration of solids in the raw sludge acts as a multiplier which helps to magnify differences which might otherwise go undetected and as a retainer which assures that single daily grab samples reflect, as much as possible, most of the material entering the system each day.

The work under this subtask involves the collection and storage by District personnel of five weeks of daily and thrice weekly grab samples of raw sludge from 10 District supervised wastewater treatment plants (Natomas, Highland, Rio Linda, San. 6, Arden, Northeast, Rancho Cordova, Meadowview, City Main and Central). Samples are to be cooled and stored at a central site. Each week's composite samples will be collected and prepared for each treatment plant by SAC personnel from a portion of each sample. The remaining portions of each sample will be freeze-dried by SAC personnel for long-term storage.

Weekly composites will be analyzed for heavy metals (cadmium, zinc, copper, nickel, beryllium, molybdenum, and selenium) by atomic adsorption spectrophotography and arc-spark emission spectroscopy and for chlorinated hydrocarbons, other PCBs and related compounds by gas chromatography. The object of these analyses will be to determine whether or not any of the plants have higher than normal levels of heavy metals or persistent organics.

Costs for this subtask will be as follows:

Sampling	
Sample program preparation - setting up sampling schedule, point of collection bottle preparation and distribution	$ 1,500.00
Sample collection - weekly round-up of County and City collected samples	2,000.00
Sample preparation and storage - freeze-drying for long-term storage	2,000.00
Analyses	
Heavy metal - 50 samples @ $70.00	3,500.00
Persistent organics - 50 samples @ $60.00	3,000.00
Total for Subtask 3.1	$12,000.00

Subtask work should be accomplished as quickly as possible, but should be scheduled to take place during a five week period with minimum interference from excessive wet weather, holiday or seasonal industrial waste flows. Work should be completed by July 1976.

DETAIL DESCRIPTION OF WORK - SUBTASK 3.2 - SOURCE SURVEY - PHASE I INFLUENT-EFFLUENT STUDIES

While raw sludge sampling provides an excellent means of monitoring for excessive heavy metals or persistent organics in system solids, it doesn't provide the interrelationships between what is collected and what is actually entering the treatment plant. To determine this information requires the examination of the contents of plant influent and effluent heavy metal and persistent organic levels in relationship to the level of similar materials in the raw sludge. This interrelationship information will also provide a check on the validity of the assumption that daily grab samples of raw sludge are representative of the entire days solids inflow.

The work under this subtask therefore will be coordinated with Subtask 3.1 and will involve the collection and storage of five weeks of daily composite samples of influent and effluent from the City Main and Central wastewater treatment plants. Individual samples will be cooled and stored at a central site. Each week's composite samples will be prepared for each treatment plant from a portion of each sample. The remaining portions of each sample will be freeze-dried for long-term storage

Weekly composites will be analyzed for heavy metals (cadmium, zinc, copper, nickel, beryllium, molybdenum and selenium) by atomic absorption spectrophotography and arc-spark emission spectroscopy and for pesticide residues, PCBs and related compounds by gas chromatography. Results will be expressed in total mg/l and the labile portion in mg/kg. The object of these analyses will be to determine whether influent and effluent levels of these materials can be related to the raw sludge levels determined by Subtask 3.1, and the plant removal efficiency.

Costs for this subtask will be as follows:

Sampling

Sample program preparation, sample collection, preparation and storage	$ 2,400.00

Analyses	
Heavy metal - 20 samples @ $70.00	$ 1,400.00
Persistent organics - 20 samples @ $60.00	1,200.00
Total for Subtask 3.2	$ 5,000.00

Subtask 3.2 work must be accomplished at the same time Subtask 3.1 work is done.

DETAIL DESCRIPTION OF WORK - SUBTASK 3.3 - SOURCE SURVEY - PHASE I
PREPARATION OF PROGRESS REPORT

During the past several years the City and County have collected extensive data on the level of many heavy metals and persistent organics within their respective collection systems. As part of the preparation of the progress report on Phase I of the source survey it is expected that this material will be reviewed and compiled into meaningful tables for inclusion in the report. It is also expected that the report will include information from the recent completed District-wide customer survey, indicating any potential sources where heavy metals or persistent organics might enter the sewerage system.

The report will review and summarize the data developed under Subtasks 3.1 and 3.2 and indicate which treatment plants (if any) are receiving abnormally high levels of either heavy metals or persistent organics. After comparing the determined levels with normal levels as developed by literature research the report will recommend which freeze-dried daily samples (if any) should be further analyzed to determine toxic material high level frequency and concentration as a means of pin-pointing actual excessive sources of these materials.

Cost of progress report preparation, including literature review, collection of all data from previous system investigations and the compiling and review of new data developed by Subtasks 3.1 and 3.2 and formulation of recommendations will be as follows:

Literature Review	
3 wk @ $25.00/hr	$ 3,000.00
Previous data review	
1 wk @ $25.00/hr	1,000.00
Report preparation	
3 wk @ $25.00/hr	3,000.00
Report production	1,000.00
Total cost for Subtask 3.3	$ 8,000.00

Most of Subtask 3.3 work can be accomplished concurrently with the work of the other two subtasks of this phase of the source control survey, therefore it is expected that this subtask can be complete by July 1976.

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 4 - SOLIDS STORAGE BASIN (SSB) STUDIES

The solids storage basins (SSBs) are considered to be a major component of the 1975 Solids Study recommended regional plant sewage sludge processing and disposal system. These deep basins provide the required buffer between the continuous 24-hour per day, 7-day per week sewage sludge receiving process (anaerobic digestion) and the 80 working day, 4 month per year disposal system (dedicated land disposal). Without this buffer full utilization of natural solar energy (algal production, evaporation and oxidation) in final disposal would be impossible.

Environmentally acceptable basins can be expected to provide the regional plant with disposal flexibility which will allow them to adjust to any climatological condition and assure the complete elimination of solids recycle within the plant's liquid process. The annual cost of the next acceptable sludge disposal system, anaerobic digestion process with dewatering and sanitary landfill disposal, was estimated in the 1975 Solids Study to be $1,000,000 more than the recommended system, anaerobic digestion process with SSBs and sludge reclamation. The proposed change to a dedicated land disposal instead of sludge reclamation will not affect this annual saving. We believe it is imperative that every effort be made to assure that the SSBs can meet every conceivable environmental limitation and that the proposed $426,000 expenditure to achieve this goal is well justified.

SSB studies involved under this task include the following eight subtasks: (1) Continuing SSB operational and performance evaluations program; (2) SSB experimental work; (3) Continuing SSB groundwater monitoring program and site engineering work; (4) Continuing of the SSB diurnal odor monitoring program; (5) SSB source odor control study; (6) Development of odor control criteria for large emission areas; (7) Feasibility study of covering existing SSBs; and (8) SSB study management, data reduction and report preparation. Work shall be as described in the following detail descriptions of work.

Final recommendation and documentation report will set forth the final design and operations criteria for incorporation of the SSBs into the Sacramento Regional Wastewater Treatment Plant.

DETAIL DESCRIPTION OF WORK - SUBTASK 4.1 - SSB STUDIES CONTINUING SOLIDS STORAGE BASIN OPERATION AND PERFORMANCE EVALUATION PROGRAM

Continuation of the existing solids storage basin (SSB) operation and performance evaluation program is essential to the success of the proposed staging of the solids managing program and the development of conclusive proof that the SSBs can do their job. SSB loading capabilities and operating variabilities must be determined for all seasons of the year. During the summer of 1975 the existing SSBs operating under controlled conditions (SSB 1 and SSB 2 - loading $\leqq$ 20 lb volatile solids/1,000 sq ft/day - surface mixing at least 12 hours/day) have been subjected to loading and mixer evaluations. Under this subtask it is expected that these type of evaluations would continue and that SAC would continue to advise on all phases of SSB operation and analyze all aspects of SSB performance.

Recommended Program and Schedule

SSB operations would continue as presently constituted until the four new SSBs become operable with mixers in August of 1976. As soon as all eight basins are fully operable it is expected that the loading on SSB 1 and SSB 2 will be held at 20 lb volatile solids/1000 square feet with the rest of the load divided on an equal area loading basis between the remaining basins. All basins are to be filled with sewage effluent as soon as their surface mixers are operable. During the 1976 period of operation of the basins at low loadings without mixers, some evaluations will be made of the long-range value of such mixers.

Solids build-up in SSB 1 and SSB 2 will continue to be closely watched. In the summer of 1976 it is expected that 4,000,000 lbs of dry solids will be harvested from the SSBs for dedicated land disposal studies. A similar harvest from the SSBs will be scheduled for the summer of 1977. While not providing the ideal maximum storage cycle, it is anticipated that detailed examination of these harvested solid's physical and pathogenic condition will provide meaningful data for estimating SSB solids storage capabilities over longer storage cycles. It is expected that the solids buildup in all SSBs will be determined on a quarterly basis.

Once all eight SSBs are operating with surface mixers, it is expected that optimum operating parameters will be established which will allow the basins to function for at least one year under routine conditions. This will allow the December 1977 SSB report to include a complete year of normal operation and performance data.

Program Monitoring

During the development of this program it is expected that both the controlled SSBs (SSB 1 and SSB 2) and the uncontrolled SSBs will continue to be monitored for the condition of their supernatant (surface layer) and solids (bottom layer) and the development of mass balances. Once all SSBs are loaded at rates of 20 lbs volatile solids per 1000 square feet or less all monitoring will be similar to that presently carried out for the controlled SSBs. The following is a resume of the suggested monitoring program for each type of SSB:

MONITORING COMMON TO ALL SSBs

Variable	Units	Frequency	Type of Sample	No. per SSB	Remarks
		Raw Sludge Input to Digesters			
Bacteria and parasites	organisms/100gm and number	quarterly	grab	-	see J222F
Virus	number	quarterly	grab	-	see J222F
		Digested Sludge Input to SSBs			
Quantity	percent	daily	-	-	each SSB, plant staff
Total solids	percent	daily	grab	-	dry wt, plant staff
Volatile solids	percent TS	daily	grab	-	dry wt, plant staff
Nutrients	percent	quarterly	grab	-	dry wt
Bacteria and parasites	organisms/100gm and number	quarterly	grab	-	see J222F
Virus	number	quarterly	grab	-	see J222F

MONITORING COMMON TO ALL SSBs (Cont'd)

Variable	Units	Frequency	Type of Sample	No. per SSB	Remarks
			Supernatant from SSBs		
Quantity	gallons	daily	-	-	each SSB, plant staff
Suspended solids	mg/l	weekly	grab	1	plant staff
Volatile solids	percent SS	weekly	grab	1	plant staff
C.O.D.	mg/l	weekly	grab	1	plant staff
B.O.D.	mg/l	weekly	grab	1	plant staff
Total nitrogen	mg/l	weekly	grab	1	plant staff
Total sulfide	mg/l	weekly	grab	1	plant staff
Total phosphorus	mg/l	weekly	grab	1	plant staff
Specific conductance	umhos/cm	weekly	grab	1	25 C, plant staff
			Harvested Sludge from SSBs		
Quantity	gallons	annually	-	-	each SSB, plant staff
Total solids	percent	-	grab	3	dry wt, plant staff
Volatile solids	percent TS	-	grab	3	dry wt, plant staff
Minerals	mg/l	-	grab composite	1	-
Nutrients	percent	-	grab composite	1	dry wt
Heavy metals	ppm	-	grab composite	1	dry wt
Chlorinated hydrocarbons	ppm	-	grab composite	1	dry basis
Bacteria	organisms/gram	-	grab composite	1	see J222F
Parasites	number	-	grab composite	1	see J222F
Virus	number		grab composite	1	see J222F

MONITORING CONTROLLED SSBs

Variable	Units	Frequency	Type of Sample	No. per SSB	Remarks
		Surface Layer			
pH	-	3/week	grab	1	plant staff
Temperature	C	3/week	grab	1	plant staff
Soluble sulfides	mg/l	3/week	grab	1	plant staff
Dissolved oxygen	mg/l	3/week	grab	1	plant staff
Conductivity	umhos/cm	monthly	grab	1	25C
Turbidity	FTU	monthly	grab	1	-
Algae count	organisms/ml	monthly	grab	1	-
		Bottom Layer			
Total solids	percent	quarterly	grab	2*	dry wt, samples every 2 ft of depth
Volatile solids	percent TS	quarterly	grab composite	2*	dry wt, samples every 2 ft of depth
Minerals	mg/l	quarterly	grab composite	1	composite only grabs > 1% solids
Nutrients	percent	quarterly	grab composite	1	dry wt, composite grabs >1% solids
Heavy metals	ppm	quarterly	grab composite	1	dry wt, composite grabs > 1% solids
Chlorinated hydrocarbons	ppm	quarterly	grab composite	1	dry basis, composite grabs >1% solids
Bacteria and parasites	organisms/100gm number	quarterly	grab composite	1	see J222F
Virus	number	quarterly	grab composite	1	see J222F

*Samples <1% solids - conductivity only.

MONITORING UNCONTROLLED SSBs

Variable	Units	Frequency	Type of Sample	No. per SSB	Remarks
		Surface Layer			
pH	-	3/week	grab	2	plant staff
Temperature	C	3/week	grab	2	plant staff
Soluble sulfides	mg/l	3/week	grab	2	plant staff
Dissolved oxygen	mg/l	3/week	grab	2	plant staff
		Bottom Layer			
Total solids	percent	quarterly	grab	2	dry wt, samples every 2 ft of depth
Volatile solids	percent TS	quarterly	grab	2	dry wt, samples every 2 ft of depth

Program Costs

The following estimate of costs is based on all samples being gathered by the plant operating staff and their performing the complete analyses on those variables for which they are listed under the monitoring program.

Monitoring Common to All SSBs - March 1976-December 1977

Raw sludge, quarterly bacteria, parasites and virus - see J222F		
Digested sludge, quarterly mineral and nutrient		
1976 3 @ $120/sample	$ 360	
1977 4 @ $135/sample	540	
quarterly bacteria, parasites and virus - see J222F		
Harvested sludge, yearly each SSB, mineral, nutrient and heavy metals		
1976 8 @ $225/sample	$1,800	
1977 8 @ $240/sample	1,920	
chlorinated hydrocarbons		
1976 8 @ $110/sample	$ 880	
1977 8 @ $125/sample	1,000	
bacteria, parasites and virus - see J222F		
Total common to all SSBs		$6,500

Monitoring Controlled SSBs - March 1976-December 1977		
Surface layer - special work to evaluate high loading or mixer variations - conductivity, turbidity, algae count		
1976 100 @ $25.00	$2,500	
1977 104 @ $27.50	2,860	
Monthly monitoring, conductivity, turbidity, algae count		
1976 64 @ $25.00	$1,600	
1977 96 @ $25.50	2,640	
Bottom layer, quarterly each SSB		
solids inventory, mineral, nutrient and heavy metals		
1976 18 @ $450.00	$8,100	
1977 32 @ $500.00	16,000	
bacteria, parasites and virus - see J222F		
Total controlled SSBs		$33,700
Monitoring Uncontrolled SSBs - March 1976-August 1976		
Bottom layer, quarterly each SSB		
solids inventory, 4 basins - 2 samples		
1976 8 @ $225.00	$1,800	
Total uncontrolled SSBs		1,800
Total Subtask 4.1 work		$42,000

All supervision and other costs required to manage this work is included under Subtask 4.8 - SSB Study Management, Data Reduction and Final Report Preparation.

Sampling and monitoring costs for work carried out by the plant staff are considered to be part of the Central treatment plant's normal operational expenses. Such work has been handled in that manner during all of 1975 and in all annual periods prior to 1975. The work has been considered to be part of the plant's routine record keeping efforts.

DETAIL DESCRIPTION OF WORK - SUBTASK 4.2 - SSB STUDIES
SOLIDS STORAGE BASIN EXPERIMENTAL WORK

Continuous operation of the existing controlled solids storage basins (SSBs) will allow for some long-range experimentation, such as changes in loadings and the need for surface mixing. However, to attempt radical experimentation with rates, time and method of loading and mixer operation on the same basis would be dangerous to the maintenance of good operation and very expensive to document. Such experimentation must be accomplished within limited time periods and must be continuously referenced to the normal operation and performance routine.

Work Elements

The following list of work elements were developed to identify all the possible operating alternatives that might affect the maintenance of desired conditions in the SSBs. From this list, a series of experiments were designed to test as many work elements as possible under controlled conditions. By observing the experiments closely, it is proposed that the effect of the changed elements will be identified and evaluated.

1. Rate of loading
    a. Slow, continuous, no rest.
    b. Maximum, intermittent (present system).
    c. Minimum, intermittent.
2. Time of loading
    a. Daytime (present system).
    b. Night.
    c. Vary with season
    d. Daily, week of rest.
    e. Daily, no rest.
    f. Two to three days per week, week of rest.
    g. Two to three days per week, every week (present system).

3. Method of loading
    - a. Dilution with SSB supernatant.
    - b. Center influent pipe.
    - c. Alternate end influent pipe
    - d. Influent end pipe near mixer (present system).
    - e. All three pipes simultaneously.
    - f. Surface layer immediately upstream of mixer.
4. Mixer operation
    - a. Continuously, 24-hour per day.
    - b. Intermittent
        - (1.) Day only.
        - (2.) Night only (present system).
        - (3.) Loading only.
        - (4.) One hour on; one hour off.

Recommended Experiments

Not all of the work elements listed warrant examination. Some are impractical from the operation standpoint (i.e. slow, continuous feed to every SSB), while others must be accomplished over a longer time period (i.e. varying loading by season) than is possible during the proposed concentrated experimentation periods.

The following five experiments incorporate the most significant and practical work elements in combinations set to yield the maximum information on the optimal operation of the SSBs. Other experiments are possible, but it is felt that the information gained from the five recommended experiments will provide indications as to what might be expected from most of the other variations. Some flexibility will be built into all experiments. If it becomes obvious that significant changes are not taking place, or that experimental periods are unnecessarily long or complicated, the work will be adjusted without jeopardizing the observations or invalidating the results obtained.

It is anticipated that SSB 1 will be used for all the experiments with SSB 2 maintained at the present operation mode throughout the experimental work as a control. The loading and monitoring for SSB 2 will not vary for each experiment. Surface layer characteristics of each basin will be monitored every few hours during each experiment. Characteristics to be monitored will include dissolved oxygen, turbidity, temperature, pH, specific conductance and algae count.

In addition to monitoring surface layer characteristics, one complete diurnal odor study will be made of experiments II through V. The study will be made during the experimental test period at a time which best reflects the most critical odor maintenance conditions.

Experiment I - Present Conditions

A period of concentrated monitoring to determine the present base case.

Experiment II - Mixing Feed with Surface Mixer

A period of concentrated monitoring to observe the effect of feeding the digested sludge into the basin directly upstream of the surface mixer. Excellent results have been achieved with this mode of operation at Auckland, N.Z.

Experiment III - Daily Feeding - No Rest

A period of concentrated monitoring to observe the effect of intermittent loading on a daily basis with no rest periods of longer than 20 hours.

Experiment IV - Supernatant Recycle

A period of concentrated monitoring to observe the effect of mixing digested sludge with five times its volume of basin supernatant prior to its discharge. Experiment should determine if dilution provides better control of odors and assure better solids distribution.

Experiment V - Optimum Modus Operandi

A period of concentrated monitoring to observe the effect of operating the basin in the mode which reflects the best of the preceding four experiments. It is expected that the mode of operation chosen for this experiment will be the result of a combination of the best features of each previous experiment and the best operation techniques developed during the continuing evaluation of SSB operation and performance covered under Subtask 4.1.

Experimental Program Schedule

Although it was originally anticipated that the SSB experimental program would start during the summer of 1975, there is no inherent limitation within the program which restricts the scheduling of the experiments. Although data collected during the winters of 1974-1975 and 1975-1976 seems to indicate that the months of January and February are the most critical to the successful maintenance of the aerobic surface layer within the SSBs, we believe that as long as SSB 2 is maintained as a control, the proposed experiments can take place during any time of the year.

Once the experiments begin, however, they should continue straight through to their conclusion. All cost estimates assume that this continuity will exist. Estimated time requirement for each experiment is as follows:

Experiment I - One week
Experiment II - Five weeks
Experiment III - Five weeks
Experiment IV - Three weeks
Experiment V - Four weeks

Program Costs

The following estimate of costs is based on 1976-77 wage schedules:

Project Supervision	$ 1,800.00
Project Manager	17,200.00
Analysis and Progress Reports	4,000.00
Equipment Rental	5,000.00
Travel Expenses	1,000.00

Experiment Costs (Labor and Laboratory Analysis)

I	$ 3,000.00
II	6,500.00
III	6,500.00
IV	4,500.00
V	5,500.00
Diurnal odor studies, one each experiment, experiments II - V	20,000.00
Total costs for Subtask 4.2	$75,000.00

DETAIL DESCRIPTION OF WORK - SUBTASK 4.3 - SSB STUDIES

CONTINUING SOLIDS STORAGE BASIN GROUNDWATER MONITORING PROGRAM AND SITE ENGINEERING WORK

Groundwater around the existing solid storage basins (SSBs) was first analyzed in September, 1974. Since that time, monthly determinations have been made of each test well to ascertain if any of the SSB contents are entering the surrounding groundwater. Determinations have included periodic complete mineral analyses and monthly partial mineral and nitrogen analysis. So far, there has been no indication that the pond contents have leached into any of the test wells.

Groundwater contamination is a major concern with SSBs. Therefore, it was essential that the test well system be expanded to surround the existing SSBs and the new SSBs constructed as part of the Interim Improvements to the Central Wastewater Treatment Plant and that the monthly tests for contamination be continued. Recent interest of the staff of the Central Valley Regional Water Quality Control Board in the results of test well analysis to date, indicate the concern of this regulatory agency.

In addition to the test well system, it is felt that soil solution measurements designed to supplement the test well data should be taken in at least two locations within the existing SSB system. Ceramic soil solution cups located below the bottom surface of the SSBs will be designed with tensiometers to detect and allow samples to be drawn from soil groundwater passing around the buried cup. Analysis of the samples is expected to provide information regarding the movement of basin contents through the bottom soil.

Once it has been ascertained that the SSBs can meet all the necessary environmental limitations it is recommended that additional site foundation engineering be accomplished within the areas shown in Fig. 5.0-1 for additional SSBs and dedicated land disposal. This work would take place in the spring of 1978 and would provide complete information on the site's hardpan and groundwater table locations.

Program Costs

Test wells around the existing and new SSBs have been installed as part of the site foundation engineering, early concern for groundwater contamination and construction Contract No. 766 (see Fig. 5.0-1). Unfortunately test wells 6, 7 and 12 are either partially or completely dry holes most of the year. New, deeper test wells to replace these dry holes should be constructed as a part of Contract No. 766 as extra work.

Costs for accomplishing the site foundation engineering for the additional SSBs and the 166 acre dedicated land disposal site have been escalated to allow for the effect of inflation.

Groundwater test well monitoring costs:		
Monthly partial mineral analysis and nitrogen content		
1976 64 @ $90/sample	$ 5,760	
1977 80 @ $100/sample	8,000	
Semi-annual complete analysis		
1976 16 @ $115/sample	1,840	
1977 16 @ $125/sample	2,000	
Total test well monitoring		$17,600
Soil solution test costs		
Construction and installation of tensiometers	$ 500	
Charging, calibrating and servicing equipment	250	
Reading, recording and servicing instruments (estimated 30 day period)	650	
Interpretation, evaluation and reporting	3,000	
Total soil solution tests		4,400
Site engineering (SSBs and 166 acre disposal sites)		12,000
Total groundwater monitoring and site engineering		$34,000

DETAIL DESCRIPTION OF WORK - SUBTASK 4.4 - SSB STUDIES CONTINUING SOLIDS STORAGE BASIN DIURNAL ODOR MONITORING PROGRAM

A $30,000 study of odors generated by the solids storage basins (SSBs) started late in the summer of 1974 (the approved authorization was accepted by SAC 9/6/74). By November, 1974, this study had provided one of the early opportunities to evaluate the sensitivity of a portable direct reading olfactometer which could be taken to the field and used for the direct measurement of low ambient odor concentrations. In addition, this early work also established the odor concentrations to be expected from the operation of uncontrolled SSBs and the seasonal atmospheric conditions which tend to accentuate odor problems.

The operation of controlled (loaded at ≤ 20 lb VSS/1,000 sq ft/day) SSBs did not start until November and December of 1974. Consequently, the diurnal odor monitoring of these controlled basins could not start until after the fall period of stable weather which is the most unfavorable to odor dissipation. To assure that the controlled SSBs were not an odor nuisance during this period of stable climatological conditions, it was essential that these studies be continued through November, 1975. An extension to the original study was requested by SAC on April 30, 1975.

The work of this extension has been carried out as a continuation of the original odor study (J215). It has included five additional diurnal studies (April, July, September, October, November), the installation of extra sensitive continuous recording wind velocity and direction and air and water temperature detection equipment and the preparation of a final report. Costs were estimated to be $33,000 and are being charged to J215. The approved authorization for the extension of J215 and its cost enlargement to $63,000 was accepted by Sacramento Area Consultants on June 25, 1975. Findings of this study are being used to determine which potential odor problems are most hazardous and require future odor studies and have resulted in some proposed 1975 Solids Study studies being dropped and others substituted.

DETAIL DESCRIPTION OF WORK - SUBTASK 4.5 - SSB STUDIES
SOLIDS STORAGE BASIN SOURCE ODOR CONTROL STUDY

Solids storage basin (SSB) diurnal odor measurements during 1974 and 1975 indicate that maximum odor emissions from controlled (loaded at $\leq$ 20 lb VSS/1000 sq ft/day) SSBs exist during periods when the basins were being fed digested sludge with a large temperature differential between the basin contents and the feed material. Concurrent studies conducted by the odor measurement subcontractor also indicate that these odors originate from the feed sludge and not from the sludge which is already in storage in the basins. These independent studies also indicated that the odors associated with the digested sludge could be air-stripped from the sludge and that once the odors were removed they did not return.

The diurnal studies carried out under Subtask 4.4 have determined that the detectable odors from controlled SSBs are of minimum magnitude and usually quickly dissipate during all but the most stable climatological conditions. However, to make sure that the controlled SSBs always meet the requirements of no detectable odor at the treatment plant boundary, the 1975 Solids Study recommended that a study be undertaken to determine if efficient, cost-effective means can be developed to eliminate the excessive odors from the digested sludge prior to its discharge into the basins.

Recommended Study

The ultimate objective of this study is to determine an efficient, reliable and cost-effective means of removing excessive odors from the digested sludge being fed to the SSBs, determining the immediate and long-range effect of this removal on controlled SSBs and to determine the best means of treating and controlling any odors so removed. To achieve this objective, it will be necessary to do the study in five phases:

Phase 1 - Design and construct necessary facilities to operate two SSBs; one with and the other without stripper facilities. This will be done by operating a pilot SSB system with two parallel 2500 sq ft basins and air-stripping facilities. One basin to operate as a controlled unstripped unit and the other as a controlled unit which is fed exclusively stripped material.

Phase 2 - Develop and evaluate alternative stripping facilities designed for effectiveness and acceleration of the process. Provide recommendations for full-scale stripping facility.

Phase 3 - Develop and evaluate alternative odorant control systems. Bench scale studies to include biological scrubbing, reactive chemical scrubbing and carbon adsorption techniques. Provide recommendations for full-scale odor control facility.

Phase 4 - Monitor operation, including diurnal odor studies, of two pilot SSBs over sufficient period to determine efficiency of stripper during months of maximum temperature differential.

Phase 5 - Provide final summary report.

Detail descriptions of these five phases, including the complete pilot scale SSB system, are presented in Appendix A of this document.

Study Schedule

It is estimated that the work of this study will take about 47 weeks to complete. Phase 1 has been assigned nine weeks (six weeks for stripper construction); phase 2, eight weeks; phases 3 and 4 to be completed concurrently in 26 weeks; and phase 5, 4 weeks. The proposed scheduling is to complete most of the work in the calendar year 1976, so it is vital that work begin as soon as possible.

Study Costs

It is estimated that the five phases of the study will cost $102,000, including an allowance of $10,000 for the construction of the pilot scale SSB system. A breakdown of these costs by phases is presented in Appendix A of this document. All costs are valid for the majority of the work being accomplished in 1976.

DETAIL DESCRIPTION OF WORK - SUBTASK 4.6 - SSB STUDIES
DEVELOPMENT OF ODOR CRITERIA FOR LARGE EMISSION AREAS

One of the impossible parameters to assess for the present controlled (loaded at $\leq$ 20 lb VSS/1000 sq ft/day) SSB operation is the effect the large surface areas of future SSB operations will have on downwind odor concentrations. Existing odor criteria have been developed based on experience with well defined point odor sources, such as stacks or ventilation discharges. There is, however, some question as to the adequacy and applicability of this criteria to nonpoint sources such as SSBs. These questions primarily relate to the source odor concentrations and the source emission rate limitations.

The diurnal odor study carried out as Subtask 4.4 provided no way of determining what this areal effect might be because controlled SSB operation was limited to SSB 1 and 2. As soon as the surface mixers are operable in SSBs 3 through 8 (now scheduled for August 1976) the surface area of controlled SSB operation will increase from 6.5 acres to 40.2 acres and conditions will exist which will support a proper investigation of this parameter. The diurnal odor study did, however, show that maximum odor concentrations usually occurred during and soon after SSB loading and during and after sunset.

Odor complaint investigations carried on by the District in 1975 indicate that the conditions which support complaints are ideal during the early fall months of August through October. During this time of year climatological conditions are excellent for odor transportation and detection. Winds are relatively calm, atmospheric temperature inverts often keep air pollutants close to the ground and the ground air temperatures are often ideal for evening outdoor activities.

Recommended Study

The objective of this study will be to determine what, if any, additive effect large areas with minimum surface odor emissions have on downwind odor concentration. Previous work allows the investigative periods to be limited to a critical 8-hour period between 3:00 and 11:00 pm and the specific climatological conditions to be created to be limited to the three identified below:

1. Stable to calm wind conditions, no artificial wind source.
2. Stable wind conditions, artificially induced 3 mph wind.
3. Moderate wind conditions, artificially induced 6 mph wind.

To achieve this objective, it is proposed that this study be divided into three phases:

Phase 1 - Application of a high intensity artificial source odor to the surface area of a single SSB, creation of the specific climatological conditions required and the monitoring of downwind odor concentrations at several locations simultaneously.

Phase 2 - Application of high intensity artificial source odor to the surface area of four SSBs, creation of the specific climatological conditions required and the monitoring of downwind odor concentrations at several locations simultaneously.

Phase 3 - Result interpretation and final report preparation. Monthly progress reports will be supplied.

Detail descriptions of these phases of the work plan, including a more detailed description of the methods proposed for the creation of the artificial source odor and the specific climatological conditions, are presented in Appendix B of this document.

Study Schedule

It is estimated that this study will take about 16 weeks to complete. Phase 1 and 2 work will take 12 weeks and be concurrent. Phase 3 work will take an additional 4 weeks. If present construction schedules do not allow this investigation to take place in the fall of 1976 due to dissimilar operation within the SSBs jeopardizing the results of the field tests (surface mixers inoperable in SSB 3 and 4 until too late in August) then it will have to be delayed until the fall of 1977. Every effort should be made to finish the study in 1976, so that 1977 is available for additional work, if required.

Study Costs

It is estimated that the three phases of the study will cost $143,000. A breakdown of these costs by phases is presented in Appendix B of this document. These costs have been adjusted ten percent for inflation on the assumption that the work may not be accomplished until 1977.

DETAIL DESCRIPTION OF WORK - SUBTASK 4.7 - SSB STUDIES

FEASIBILITY STUDY OF COVERING EXISTING SOLIDS STORAGE BASINS

As indicated in Chapter IX of the SRWMP 1975 Solids Study, one of the alternatives to development of acceptable odor controlled solid storage basins (SSBs) would be to cover the existing eight basins and force the escaping odors through scrubbers and filters prior to its release to the atmosphere. It is expected that operation of the SSBs under these circumstances would be on a fill and draw basis and that sufficient consolidation would take place within the basins to assure their use as a buffer between the digesters and the final form of disposal.

In addition to the possible use of covered basins as an alternative storage system, it has also been suggested by the District's Review Board that consideration be given to the covering of SSB 1 and/or SSB 2 to allow for emergency dumps of "sour" sludge from malfunctioning digesters. To ascertain the feasibility of covering such large basins and to determine how they will function, SAC recommended and the District approved, the hiring of specialists in the design of air-supported structures to prepare a detailed feasibility study on the covering of the existing SSBs.

Study Results

This feasibility study determined design factors for SSB covers, including such items as the correct material to be used, structural concepts to be employed, wind and weather effects, accessibility for men and equipment, support equipment requirements, gas release controls, life expectancy and operating costs. In addition, the study also answered construction questions regarding the cover's installation over in-service basins and determined maintenance procedures which were necessary to assure maximum life. All determinations were documented in a final report.

Study Schedule

The study was completed and submitted to the District on December 18, 1975.

Study Costs

The cost for this feasibility study was $2,864.40 plus SAC management time. This cost is included in the actual and estimated costs for Subtask 1.1.

DETAIL DESCRIPTION OF WORK - SUBTASK 4.8 - SSB STUDIES
SOLIDS STORAGE BASIN STUDY MANAGEMENT, DATA REDUCTION AND REPORT PREPARATION

At the time of completion of the SRWMP 1975 Solids Study, many questions still remained to be answered regarding the solids storage basins' (SSBs) effect on the environment. The 1975 Solids Study clearly indicated the advantages of using the SSBs as part of the recommended processing and disposal system, but at the same time, it also pointed out the need for the gathering of additional operation and performance information on their effect on atmospheric odors, groundwater pollution and final disposal criteria.

The first seven subtasks of the proposed SSB studies are designed to gather this information. To assure efficient use of the existing facilities during this gathering process and the proper coordination of the various parts of the study requires the entire study to be managed by SAC. SAC should also be assigned the overall task of data analysis and the preparation of the final report.

The solids program schedule for the SSB studies (Task 4) calls for the study's final report to be submitted at the end of December, 1977. It is expected that this report will provide final recommendations for design and construction of the final 12 SSBs which must be added to the District's sludge processing system to provide for the regional plant's sludge. Present plans call for the regional plant's contract to exclude the construction of these twelve basins. It is expected that the basins will be constructed under a separate contract which will bid during the summer of 1978. This schedule will allow the District, State and Federal authorities six months to review and decide on the final disposition of the SSB issue. We believe this time allowance will be adequate for the issue involved.

It is estimated that the cost of this subtask will be $30,000 (including inflation allowances). Of this amount $15,000 is expected to cover the cost of data analysis and final report preparation and the remaining $15,000, or approximately $680 per month, the cost of study management.

SEWAGE SLUDGE MANAGEMENT PROGRAM
TASK 5 - DEDICATED LAND DISPOSAL STUDY

Present Federal and State regulatory policy for the disposal of sewage sludge to land is in a state of flux. Federal guidelines have been imminent since the spring of 1974 and the latest information from Washington is that they still are at least 6 months away. State policy has been confused by the creation in 1974 of the Solid Waste Management Board and the apparent overlapping between their proposed regulations and existing Regional State Water Quality Control Board regulations for sanitary landfill disposal.

An August 1975 preliminary working draft of proposed statewide standards for sewage sludge treatment, disposal and reclamation being developed by the California Department of Health for the Solid Waste Management Board provides the most current indication of State policy. These proposed standards set forth the following criteria for sewage sludge disposal to land.

"VIII. Criteria for Sewage Sludge Disposal to Land. Stabilized sludge destined for disposal in a landfill or on lands dedicated to sludge disposal shall have discharge specifications and monitoring as prescribed by the RWQCB.

Disposal procedures shall be approved by the Department or the local health entity.

Liquid digested sludge shall not be spread on the open face of refuse containing putrescible materials."

The dedicated land disposal study has been designed to provide the RWQCB and State and local health entities with complete data to formulate the prescribed discharge specifications, monitoring and disposal procedures which will completely protect the environment. From recent verbal communications with the Federal regulatory personnel it is anticipated that such disposal procedures will also comply completely with EPA guidelines. The study involves evaluating various methods of applying stabilized sewage sludge to land dedicated exclusively for such use and monitoring the effects on soil, groundwater and surface water runoff from such applications. For the purpose of this study this work has been divided into the following three subtasks: (1) management and report preparation;

(2) site development and sludge spreading, and (3) sludge and disposal site monitoring. Work shall be as described as follows.

DETAIL DESCRIPTION OF WORK

Sacramento Regional County Sanitation District (SRCSD) plans to construct a regional wastewater treatment plant in the vicinity of Freeport which will consolidate existing treatment plants. It is proposed to apply the stabilized sewage sludge produced by this plant annually to nearby land. This dedicated land disposal study will evaluate different methods of sludge application for compatibility with the environment, cost-effectiveness, and the maximum sludge application rate in tons per acre per year that can be safely applied to the land. Monitoring for environmental effects from these applications will be carried out for the full four year study.

Task Objectives

The experimentation, data gathering and information extraction process will be designed and directed to achieve the following objectives:

1. To measure the base levels of constituents in soils which will be affected by the application of sewage sludge.
2. To monitor during the experimental period transformations and redistribution of sludge solid components to the groundwater and surface runoff. All surface runoff shall be captured and treated at the nearby Central treatment plant.
3. To measure annually the changes in chemical composition and physical properties of the soil receiving sewage sludge applications.
4. To select the sewage sludge application method that will:
    a. Allow for the maximum annual sludge application rate and yet not be limited by undesirable discharge to ground or surface waters. The main advantage of this determination will be the minimizing of the amount of land necessary to dispose of an estimated 22,000 - 32,000 tons of dry sewage sludge per year.
    b. Be the most cost-effective. Strong consideration will be given to the method which lends itself to automation in sludge application,

thereby reducing the number of manhours required for the sludge disposal operation, provides the most flexibility in handling a range of application rates, and is the most likely to be unaffected by climatological variations.

5. To achieve a nonhazardous working environment by maintaining acceptable public health vector controls.

General Work Plan

Field Studies

The dedicated land disposal study area of approximately 34 acres will be located just south of the proposed Sacramento Regional Wastewater Treatment Plant (Fig. 5.0-1). The parcel of land is located outside of the operation and work areas of both the existing Central treatment plant and the proposed new regional treatment plant. It is anticipated that this site will remain undisturbed during all construction activities and that it will be able to be part of the ultimate dedicated land disposal system for the new regional facility.

Four years will be required to complete the physical tasks of this study. One year will be devoted to sewage sludge application and monitoring for each of three application methods: plow down or direct injection, furrow type spreading, and flooding. After evaluation of results from the first three years, a fourth year will be utilized for further monitoring and refinement of the sludge application method judged to be superior of the three.

Soil samples for analysis will be taken annually from inside and outside the disposal site to a depth of four feet.

Runoff from the disposal site will be collected periodically during the rainy season.

Soil solution samples will be collected from within the disposal site after sewage sludge applications and during the rainy season and from outside the disposal site during the rainy season.

Piezometers inside and outside the disposal site will be utilized for recording groundwater levels and for sampling, assuming groundwater is encountered.

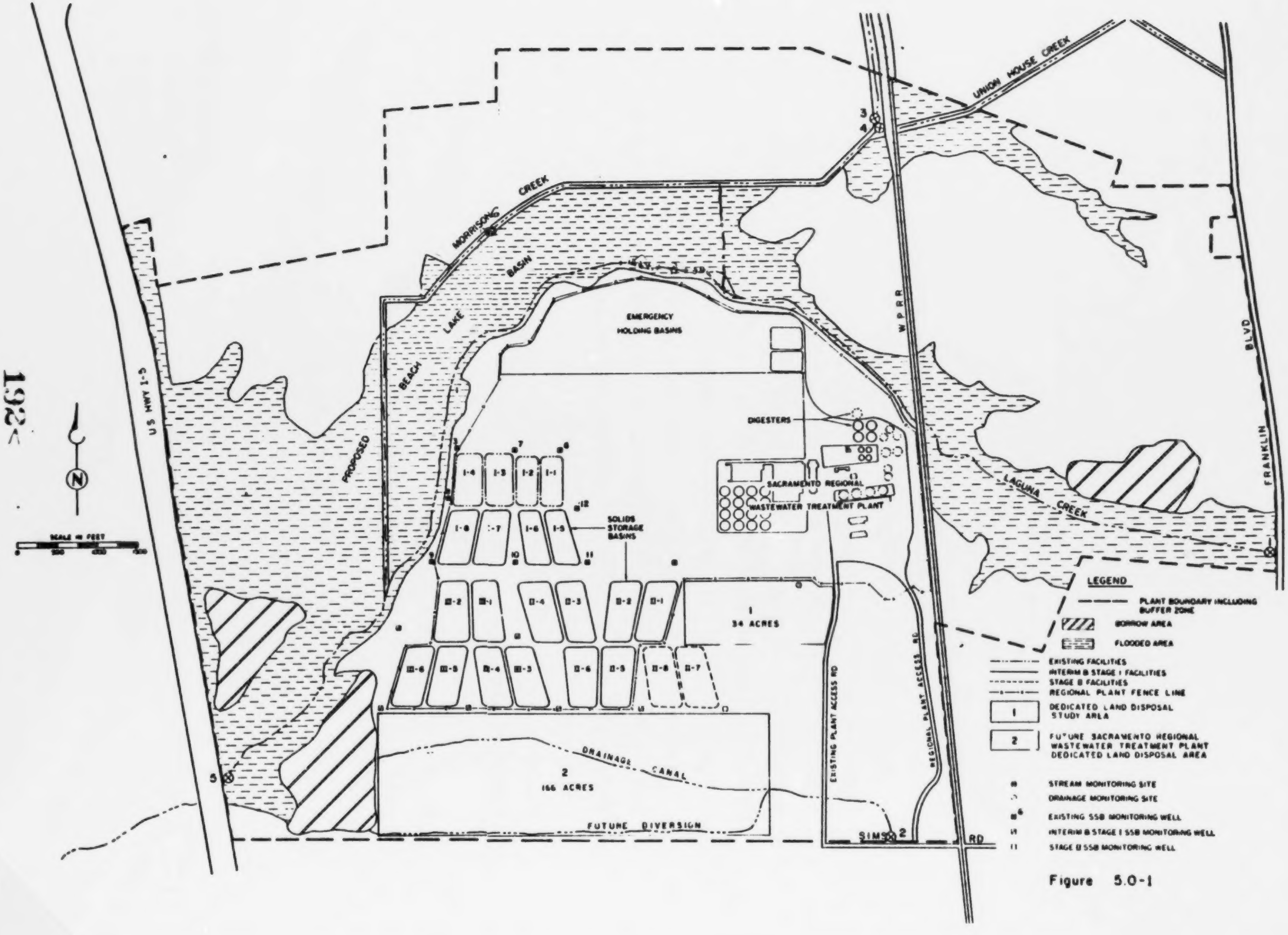

UNION HOUSE CREEK
FRANKLIN BLVD
3
4
W P R R
MORRISON CREEK
PROPOSED BEACH LAKE BASIN
EMERGENCY HOLDING BASINS
DIGESTERS
SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT
LAGUNA CREEK
SOLIDS STORAGE BASINS
I-1
I-2
I-3
I-4
I-5
I-6
I-7
I-8
II-1
II-2
II-3
II-4
II-5
II-6
II-7
II-8
III-1
III-2
III-3
III-4
III-5
III-6
1 34 ACRES
2 166 ACRES
DRAINAGE CANAL
FUTURE DIVERSION
EXISTING PLANT ACCESS RD
REGIONAL PLANT ACCESS RD
SIMS RD
2
5
US HWY I-5
SCALE IN FEET
0
500
1000
1500
N
LEGEND
PLANT BOUNDARY INCLUDING BUFFER ZONE
BORROW AREA
FLOODED AREA
EXISTING FACILITIES
INTERIM & STAGE I FACILITIES
STAGE II FACILITIES
REGIONAL PLANT FENCE LINE
1 DEDICATED LAND DISPOSAL STUDY AREA
2 FUTURE SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT DEDICATED LAND DISPOSAL AREA
STREAM MONITORING SITE
DRAINAGE MONITORING SITE
EXISTING SSB MONITORING WELL
INTERIM & STAGE I SSB MONITORING WELL
STAGE II SSB MONITORING WELL

Figure 5.0-1

Shallow tensiometers located within the disposal site will be used for indicating saturated subsurface soil conditions that could result from sewage sludge application.

Creek water flowing through the treatment plant site will be sampled monthly at upstream and downstream locations.

Modifications

It is recognized that modifications to this original work plan may be advisable at some point in the study. These modifications may take the form of altering the application or sampling program or the analytical parameters sought, or both.

Major modifications will be made only with concurrence of District and SAC sludge program management because such changes may affect other aspects of the overall sludge disposal program. However, it should be emphasized at this point that the study costs may be considered maximal. Therefore, any modifications to the experimental program are expected to be able to be made within the indicated total study cost. Total estimated cost for the dedicated land disposal study is $598,000.

DETAIL DESCRIPTION OF WORK - SUBTASK 5.1 - DEDICATED LAND DISPOSAL STUDY - MANAGEMENT AND REPORT

The work of this subtask involves the overall management and coordination of the dedicated land disposal study by Sacramento Area Consultants and the planning and general supervision of the actual field studies by Dwight Baier. SAC work includes, but is not limited to, the maintenance of good communications between subcontractors and between subcontractors and the district, proper coordination between the project's use of sewage sludge and the District's need to dispose of this sludge, review and approval of all task costs, and the responsibility of seeing that the work stays on schedule.

Dwight C. Baier will be responsible for planning and acquisition of spreading equipment, design of site improvements, installation of monitoring equipment and the general supervision of spreading and monitoring activities. Monthly, quarterly and annual reports will be prepared by Mr. Baier for transmission to the District via the SAC coordinator. Monthly reports will be brief, covering only significant activities and events. Quarterly reports will cover results that have been obtained and brief comments thereon. Annual reports will show results of tests, analysis, and comments on the results, and where appropriate, make recommendations for changes in procedure. At the end of the study, Mr. Baier will summarize and analyze all findings and provide SAC with conclusions and recommendations which relate to the study objectives.

Subtask Time and Budget Estimate

The estimated 4-year budget for Subtask 5.1 is as follows:

ESTIMATED SUBTASK 5.1 BUDGET
MARCH 1976 - DECEMBER 1979

Overall Management and Coordination (SAC - 30 hrs/mo)	$ 50,000
Planning, General Supervision, Reports (DCB - 1 day/wk)	58,000
Final Report Preparation and Publication (DCB)	15,000
Total	$123,000

An arbitrary ten percent inflation factor has been included in the management budget each year after 1976. Total cost for this subtask is estimated to be $123,000.

DETAIL DESCRIPTION OF WORK - SUBTASK 5.2 - DEDICATED LAND DISPOSAL STUDY - SITE DEVELOPMENT AND SLUDGE SPREADING

Description of Subtask Work

Work of this subtask will consist of development of the dedicated land disposal study area and of testing and evaluating three methods of sewage sludge application. The study area has been chosen for its immediate availability, its convenience to the existing SSBs and its ultimate location outside of the regional plant construction site. As soon as the study is authorized it is intended that several soil samples will be taken to assure the existence of sufficient hardpan throughout the site to provide the necessary isolation between the surface applied waters and existing ground waters. If the site does not reasonably satisfy this requirement, a more appropriate site will be chosen.

Three methods of sludge application will be examined during the course of the work. Each year each method will be asked to apply up to 2000 tons (dry wt) in the liquid state to the dedicated land disposal study area shown in Fig. 5.0-1 at rates between 150 and 200 tons (dry wt)/acre/year. Liquid stabilized sludge will be pumped directly from the solids storage basins (SSBs) at about five percent solids by the District's "Mudcat" dredge to the land disposal site during the four summer months with the highest average of sunshine and maximum amount of evaporation (June-September). It is estimated this period will contain approximately 80 working days.

Due to the minimal site preparation required and the ready availability of the necessary equipment, the study will commence during the summer of 1976 using the plowdown (direct injection) method of sludge application. In this way, sufficient time will be available to design and prepare the site for the furrow type spreading during 1977 and flooding in 1978.

Also shown in Fig. 5.0-1 is the location of a proposed 166 acre Sacramento Regional Wastewater Treatment Plant dedicated disposal site. It is anticipated that this acreage, in combination with that of the dedicated land disposal study area, would supply sufficient land area to accommodate future sludge disposal needs for the next 20 years at application rates of less than 170 tons (dry wt)/acre/year.

Subtask Budget Estimates

The estimated 4-year budget for Subtask 5.2 is as follows:

ESTIMATED SUBTASK 5.2 BUDGET
MARCH 1976 - DECEMBER 1979

Site Preparation, Leveling and Fencing for 34 acres	$ 18,000
2000 Feet of 12-inch Portable Irrigation Pipe	6,000
Spreading Costs, 2000 tons (dry wt)/yr, for 4 years (manpower and equipment)	186,000
Total	$210,000

An arbitrary ten percent inflation factor has been added for spreading costs for each year after 1976. Spreading cost estimates must be regarded as flexible inasmuch as there is little background of experience in such operations. We believe, however, that the costs allowed are conservative and do not expect them to be exceeded. Total cost for this subtask is $210,000.

DETAIL DESCRIPTION OF WORK - SUBTASK 5.3 - DEDICATED LAND DISPOSAL STUDY - SLUDGE AND DISPOSAL SITE MONITORING

Description of Subtask Work

An intensive monitoring program of the sludge applied and the soil and water at the land disposal site is an integral part of the study to assure the determination of the environmental acceptability of each sludge solids application method. The monitoring program will include field sampling and laboratory sample analyses.

Sampling

Proposed locations for on-site soils and water sampling are shown in Fig. 5.3-1. Runoff and creek water sampling sites are shown in Fig. 5.0-1.

Six kinds of samples must be taken to document the environmental effect of sludge spreading. These include:

1. Sewage sludge
2. Soils
3. Soil solutions
4. Groundwater
    a. Chemical analysis
    b. Level recording
5. Runoff water
6. Creek water

Sewage sludge. Twelve composite samples of the sludge will be collected from the harvested sludge each year. It is extremely important that these samples be as representative as possible.

Soils. Representative soil samples will be taken annually from within and around the disposal site. Depths will be as shown in Table 5.3-1. Where possible soil samples will be stored so they can be reanalyzed, if necessary, at a later time.

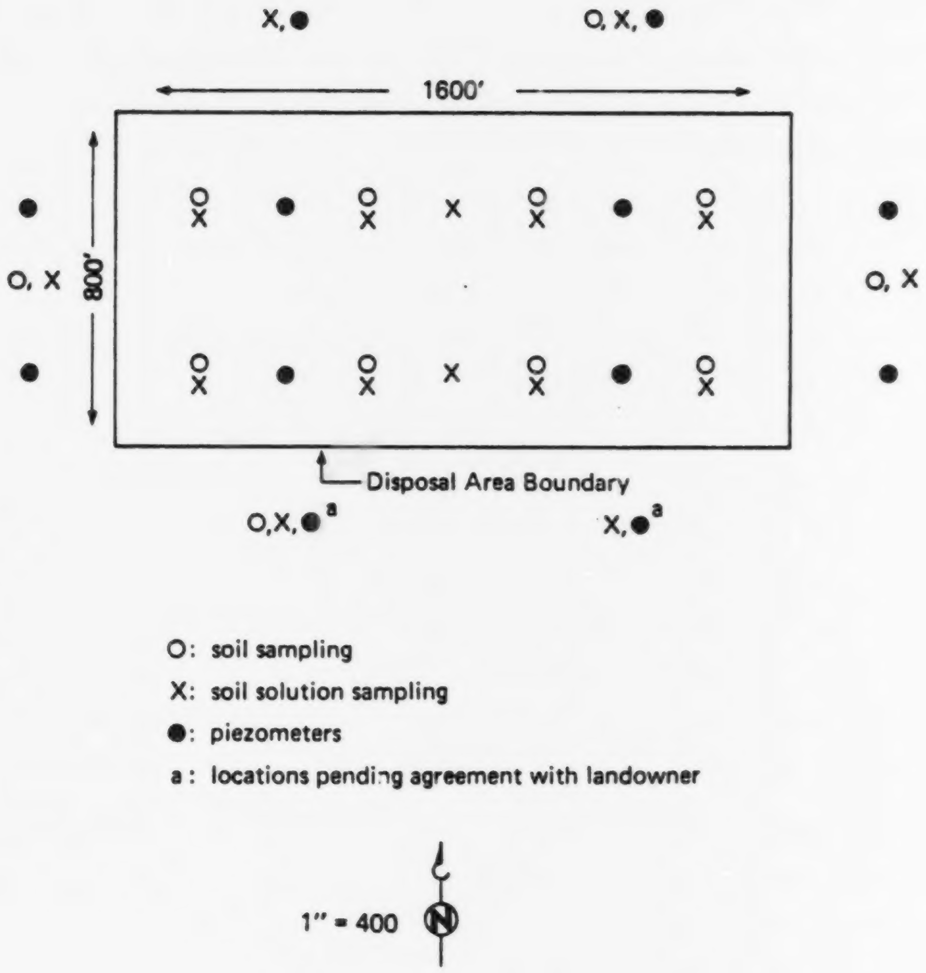


Figure 5.3-1 Dedicated Land Disposal Study
Preliminary Layout of Monitoring Stations

Table 5.3-1

Dedicated Land Disposal Study

Approximate Number of Samples to be Processed Per Year and Analytical Parameters Sought in Each Sample

Sample description	Parameters	Number of samples[d]
Sludge solids	EC, NO_3, PO_4, SO_4, HCO_3+CO_3, Cl, Ca, Mg, Na, K, pH, TKN, NH_3, TP, B, Zn, Cu, Cr, Pb, Ni, Ag, Cd, Hg, Be, Mo, Se, total and volatile solids (%), chlorinated hydrocarbons, other PCB's.	12
Soils[a]	Saturation extracts: pH, EC, NO_3-N, PO_4-P, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH, B, and saturation percentage.	48
	DTPA extracts: Cu, Zn, Cd, Ni.	
	Special analysis: CEC, TKN, NH_4, B, organic %.	
	Pesticide residue: chlorinated hydrocarbons, other PCB's.	
Soil solution	EC, NO_3, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH.	128
	Zn, Cd, chlorinated hydrocarbons, other PCB's	43(of 128)[b]
Groundwater	EC, NO_3, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH.	24
	Zn, Cd, chlorinated hydrocarbons, other PCB's	8(of 24)[c]

Table 5.3-1 (continued)

Sample description	Parameters	Number of samples[d]
Runoff water	pH, EC, turbidity, Zn, Cu, Cd, Ni, Pb, Hg, TKN, NO_3, NH_3, TP T Coli, F Coli, F Strep, chlorinated hydrocarbons, other PCB's.	12
Creek water	(Same as for runoff)	60

[a] Sampled annually at 0-6, 6-12, 12-24, 24-48 inch depths; 4 depths x 12 locations = 48 samples.

[b] 43 of the potential samples will also be analyzed for PCB's, Cd, and Zn.

[c] 8 of the potential 24 groundwater samples will also be analyzed for PCB's, Cd, and Zn.

[d] Number of samples may be changed during life of project to adjust to varying conditions.

Soil solutions. Within the disposal site, soil probes will be installed above and below the clay layer. By applying a vacuum to these probes, samples of the soil solution will be collected immediately after each year's sludge application period and during the rainy season. Soil solution samples will also be taken from outside the disposal site during the rainy season. All instruments inside the disposal site will be buried to assure minimum interference with sludge application equipment.

Groundwater. Piezometers will be located inside and outside the disposal site where samples will be taken if groundwater is encountered. When groundwater is encountered, samples of the water involved will be collected at least twice per year or as seems warranted by characteristics of water movement, its salinity, and its sensitivity to sludge application. In addition groundwater will also be monitored throughout the year in order to document the direction of groundwater flow and any changes in water level that might occur as a result of sludge application. Within the disposal area shallow tensiometers will aid in identifying saturated subsurface soil conditions above the clay layer.

Runoff water. Samples of runoff water from the disposal site will be collected during the rainy season. Application methods and rates will be controlled so there will not be surface runoff during the sewage sludge application period.

Creek water. Tributary streams will be sampled at five locations as part of a program of sampling initiated in 1975.

Laboratory Analysis

Samples will be analyzed in accordance with Table 5.3-1 by a commercial laboratory. As the project progresses, it may become apparent that certain analysis can be safely curtailed and that others need to be expanded or augmented.

All commercial laboratory analysis will be made according to procedures approved by standard methods and where applicable by the University of California at Davis Department of Soils and Plant Nutrition.

Subtask Time and Budget Estimates

The estimated 4-year budget for Subtask 5.3 is as follows:

ESTIMATED SUBTASK 5.3 BUDGET
MARCH 1976 - DECEMBER 1979

Instrument Installation	$ 1,000
Sludge Solids	15,000
Soils	58,000
Soil Solution	68,000
Groundwater	20,000
Runoff Water	18,000
Creek Water	85,000
Total	$265,000

Costs for the different types of samples includes costs for sampling and analysis. An arbitrary ten percent inflation factor has been included for each year after 1976. Total cost for this subtask is estimated to be $265,000.

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 6 - MISCELLANEOUS USE DETERMINATIONS

Miscellaneous use determinations involves the following two subtasks: (1) a microbiological study including a monitoring program capable of meeting proposed Federal, State and local environmental and public health requirements, determining the effectiveness of the proposed sewage sludge processing system in destroying selected index organisms and providing direction towards sludge management practices which will achieve a cost-effective, public health hazardless, sludge disposal system, and (2) a virus study including a monitoring program capable of meeting proposed Federal, State and local environmental and public health requirements, determining the effectiveness of the proposed sewage sludge processing system in destroying virus and providing direction towards sludge management practices which will achieve a cost-effective, public health hazardless, sludge disposal system. Work shall be as described in the following detail descriptions of work.

DETAIL DESCRIPTION OF WORK - SUBTASK 6.1 - MISCELLANEOUS USE DETERMINATIONS - MICROBIOLOGICAL STUDY

One of the major concerns of Federal, State and local regulatory agencies regarding the disposal of sewage sludge is the hazards created by the survival of pathogens and other specific organisms. The August 1975 preliminary working draft of the State Department of Health standard governing sewage sludge treatment, disposal and reclamation is very specific regarding these hazards and indicate that extensive monitoring will be required to assure that any form of disposal or utilization is safe. In addition, if such monitoring doesn't indicate set levels of destruction specific use restrictions will probably be imposed. Unless the SRWMP sludge management program can show that the proposed sewage sludge processing system will produce a final product in compliance with the levels proposed, it is possible that final system will have much higher sludge handling and disposal costs.

Objectives

The microbiological study is designed to assure that the District will be able to meet or exceed the finally adopted state health standards for protecting public health during the storage, conveyance, application and final disposal of the sewage sludge. It will include the formulation and implementation of a microbiological monitoring program (Table 6.1-1) which will be coordinated with the other subtasks of the Sludge Management Program (1.1 and 5.3) to provide the factual data related to the presence (species and numbers) of selected index organisms including parasitic helminths, pathogenic protozoans and bacteria. Semi-annual interpretations will be provided during the course of the study to assist in directionalizing the program to its most cost-effective conclusion.

Correlative use will be made of microbiological data obtained previously in connection with the nearly 3 years of soil enrichment studies conducted by the East Bay Municipal Utility District whenever possible. Previous meetings between the two Districts already indicate this willingness to share results. It

SCOPE OF WORK

Table 6.1-1

Project Period	Item	Type	Frequency	Presence and Quantitation for Helminths**	BACT*	Protozoans
Dec., 1975 to Dec., 1976	Existing SSB sludges	Composite 1 site/pond 3 depths	Quarterly	x	x	x
	Raw sludge	Composite	Quarterly$^+$	x	x	x
	Digested sludge	Composite Middle & Bottom Digester	Quarterly$^+$	x	x	x
	Harvested sludge	Composite	As required	x	x	x
	Sludge treated soils	Triplicate and Control	Quarterly$^+$	x	x	x
	Surface runoff	Triplicate and Control	Twice during rainy season$^+$	x	x	x
	Creek water	Grab, 8 sites	Five per year	-	x	-
Jan., 1977 to Dec., 1979	Selected SSBs sludge	Composite 1 site/pond 3 depths	As required based upon findings 1975-1976	x	x	x
	Raw sludge	Composite	As required based upon findings 1975-1976$^+$	x	x	x
	Digested sludge	Composite Middle & Bottom Digester	Quarterly$^+$	x	x	x
	Harvested sludge	Composite	As required based upon findings 1975-1976$^+$	x	x	x
	Sludge treated soils	Triplicate and Control	As required$^+$	x	x	x
	Surface runoff	Triplicate and Control	Twice during rainy season season$^+$	x	x	x
	Creek water	Grab, 8 sites	Five per year	-	x	-

*BACT - Salmonella sp., Shigella sp., Fecal Coliform, Fecal Streptococci
**includes viability tests for embryonated isolates
$^+$correlate to EBMUD data where appropriate

is anticipated that the sharing will save many thousands of dollars in needless duplication.

Organization

The microbiological studies will be under the direct supervision of Dr. David Storm, President of Spray-Wastes Inc., in association with Dr. Jerold H. Theis, Parasitologist in the University of California at Davis School of Medicine, Department of Medical Microbiology and Quiger Laboratories. Dr. Theis will be responsible for the laboratory analysis in connection with the determination of occurrence, density, and viability of parasitic helminths and pathogenic protozoans. Quiger Laboratories will have the responsibility for determining the presence and density of index bacteria. Coordination with other sludge management subtasks will be supervised by SAC.

Methodology

Bacteria: The standard 3-level test for Salmonella sp., Shigella sp., Fecal Coliform and Fecal Streptococci will be performed on all sludge, solids, soil, irrigation runoff, and creek water. Identification will be made of isolates shown to be present in the completed test. Quantitative determinations will be made for total mesophilic aerobic forms, shigella, salmonella and Fecal Streptococci and reported as number of organisms per 100 grams of soil sludge or solids.

Helminths and Protozoans: Six (6) 15 ml test tube samples for each sample of soil, sludge, solids, and irrigation or runoff will be prepared using standard sedimentation and flotation techniques (saturated zinc sulfate and 10% buffered formalin, respectively). Slides will be prepared from each aligot sample and examined under a compound microscope. Quantitation will be accomplished using the MacMaster's slide technique. Viability tests of helminths will be made by hampster inoculation with isolated ova and autopsy of the hampster 30 days after inoculation.

Reports

Monthly progress status reports will include all sampling and analysis data developed during the previous 30 day period. Semi-annual interpretations of data will be provided in letter report form. Monthly report data would be compiled, interpreted and statistically tested at the end of each calendar year. This will be documented in an interim annual report which will also contain conclusion and recommendations for the subsequent year's detailed monitoring requirements as influenced by the previous year's test results. As can be observed by a close examination of Table 6.1-1 the monitoring program for subsequent years has been reduced to match anticipated favorable results of an initial comprehensive surveillance program. A final report will be prepared to summarize annual findings and provide recommendations for the future monitoring requirement of the SRWTP sewage sludge disposal system.

Schedule and Costs

The microbiological study is expected to continue throughout the life of the Sewage Sludge Management Program (March 1976 - December 1979). Costs will be as detailed below:

Period	Item	Estimated cost	Remarks
March 1976 - Dec. 1976	SSBs sludge	$ 19,800	3 depths, 8 sites, 1 composite sample per site, 5 samplings/period
	Raw sludge	825	1 composite, 5 samplings/period
	Digested sludge	2,475	3 locations, 1 digester, 1 composite, 5 samplings/period
	Harvested sludge	825	1 composite, 5 samplings/period
	Treated soils	3,300	1 plot, 4 samples, 5 samplings/period
	Treated soils runoff	3,300	1 plot, 4 samples, 5 samplings/period
	Creek water	2,000	5 sites, 5 samplings/period
	Subtotal	$ 32,525	
	Sampling, report preparation, correlation, interpretation, and progress meetings	$ 4,500	
	Expenses	500	
	Total 1975-76 Subcontract	$ 37,525	
	Total SAC 1975-76	2,000	
		$ 39,525	

Period	Item	Estimated cost	Remarks
Jan. 1977 - Dec. 1979	SSBs sludge	$ 23,760	3 depth, 4 sites, 1 composite sample, 12 samplings/period
	Raw sludge	1,980	1 composite, 12 samplings/period
	Digested sludge	5,940	3 locations, 1 digester, 1 composite, 12 samplings/period
	Harvested sludge	5,940	1 composite, 12 samplings/period
	Treated soils	7,920	1 plot, 4 samples, 12 samplings/period
	Treated soil runoff	1,980	1 plot, 4 samples, 3 samples/period
	Creek water	6,000	5 sites, 15 samplings/period
	Subtotal	$ 53,520	
	Sampling report preparation, correlation, interpretations and progress meetings	13,500	
	Inflationary escalation allowance	16,000	
	Expenses	1,200	
	Total 1977-79 Subcontract	$ 84,220	
	SAC 1977-79 (incl. inflation allow.)	7,000	
	Total cost	$ 91,220	
	Cost of Subtask 6.1	$130,745	

Total cost for Subtask 6.1, including a ten percent inflation allowance, is estimated to be $131,000.

DETAIL DESCRIPTION OF WORK - SUBTASK 6.2 - MISCELLANEOUS USE DETERMINATIONS - VIRUS STUDY

Another of the major concerns of Federal, State and local regulatory agencies regarding the disposal of sewage sludge is the hazards created by the survival of virus. The August 1975 preliminary working draft of the State Department of Health standard governing sewage sludge treatment, disposal and reclamation is very specific regarding this hazard and indicates that extensive monitoring will be required to assure that any form of disposal or utilization is safe. In addition, if such monitoring doesn't indicate set levels of destruction, specific use restrictions will be imposed. Unless the SRWMP sludge management program can show that the proposed sewage sludge processing system will produce a final product in compliance with the levels proposed, it is possible that the final system for disposal will be much more expensive.

Objectives

The virus study is designed to assure that the District will be able to meet or exceed the finally adopted State health standards for protecting public health, during the storage, conveyance, application and final disposal of the sewage sludge. It will include the formulation and implementation of a virus monitoring program (Table 6.2-1) which will be coordinated with the other subtasks of the sludge management program (1.1 and 5.3) to provide the factual data related to the presence of selected virus and their survival rate as they pass through the sludge processing system. Semi-annual interpretations will be provided during the course of the study to assist in directionalizing the program to its most cost-effective conclusion.

Organization

The virus study will be under the direct supervision of Dr. David Storm, President of Spray-Wastes Inc. Dr. Robert Quinn of the University of California at Davis Department of Biochemistry will conduct the viral isolations and perform the quantitative analysis. Dr. Fredric Troy will serve as special consultant in matters related to phytoaglutin absorption processes and laboratory control.

Table 6.2-1

SCOPE OF WORK

Project period	Item	Type	Frequency	Number of samples	Analytical procedure
January 1976 - December 1976	Raw sludge	Composite	Quarterly	3	**
	Digested sludge	Composite	Quarterly	3	**
	SSB's	1 site/pond 3 depth composite	Quarterly	22	**
	Harvested sludge	Composite	As required	4	**
	Surface runoff	1 site, 2 samples each site	Each major winter storm event (say 3 per annum)	6	**
	Creek water	2 sites (1 upstream of plant (composite) and 1 downstream)	Quarterly	6	**
				44	First year subtotal
January 1977 - December 1979	Raw sludge	(Same as above)	(Same as above)	12	**
	Digested sludge	(Same as above)	(Same as above)	12	**
	SSB's	(Same as above)	(Same as above)	96	**
	Harvested sludge	(Same as above)	(Same as above)	12	**
	Surface runoff	(Same as above)	(Same as above)	18	**
	Creek water	(Same as above)	(Same as above)	24	**
				174	Tri-annum subtotal
				218	Samples per 4 year surveillance period

**Phytoaglutin absorption (Sepharose 4B, Concanavalin-A linked beads in suspension. Quantitation by radio-immunoassay.)

Coordination with other sludge management subtasks will be supervised by SAC.

Methodology

Hepatitis Type-B (serum hepatitis) Antigen will be used as the index viral agent. Hepatitis Type-B Antigen was selected because (1) it is an ubiquitous infection among urban populations, (2) the viral agents are excreted in the urine and feces of infected individuals and healthy carriers, and (3) the analytical procedures for isolating and identifying and quantifying the viral agent are reasonably well defined. Unfortunately it is a highly infectious viral agent and does require that isolating, identifying and quantifying be done within super safe facilities. The costs for creating these facilities is reflected in the high costs for the first six samples ($10,000).

Reports

Laboratory results accompanied by summary progress reports will be submitted monthly. Annual reports will be prepared giving interpretations of data, statistical testing and recommendations for the subsequent year's detailed monitoring requirements as influenced by the previous year's test results. A final report will be prepared to summarize annual findings and provide recommendations for the future monitoring requirement of the SRWTP sewage sludge disposal system.

Schedule and Costs

The virus study is expected to continue through the life of the Sewage Sludge Management Program (March 1976 - December 1979). Costs will be as detailed below:

March 1976 - December 1976	
First six (6) samples	$10,000
Next thirty-eight (38) samples @ $300	11,400
January 1977 - December 1979	
One hundred and seventy four (174) samples @ $360	$62,600

Analytical Cost Subtotal	$84,000
Report Preparation	4,000
SAC Management and Coordination (includes inflation allowance)	7,000
Total Subtask 6.2	$95,000

Total cost for Subtask 6.2, including a ten percent inflation allowance, is estimated to be $95,000.

APPENDIX A

Proposal of EUTEK
for
Odor Control by Stripping
Digested Sludge Feed

(Work covered by this proposal is incorporated in Subtask 4.5)

APPENDIX A

PROPOSED WORK PLAN: ODOR CONTROL BY STRIPPING DIGESTED SLUDGE FEED

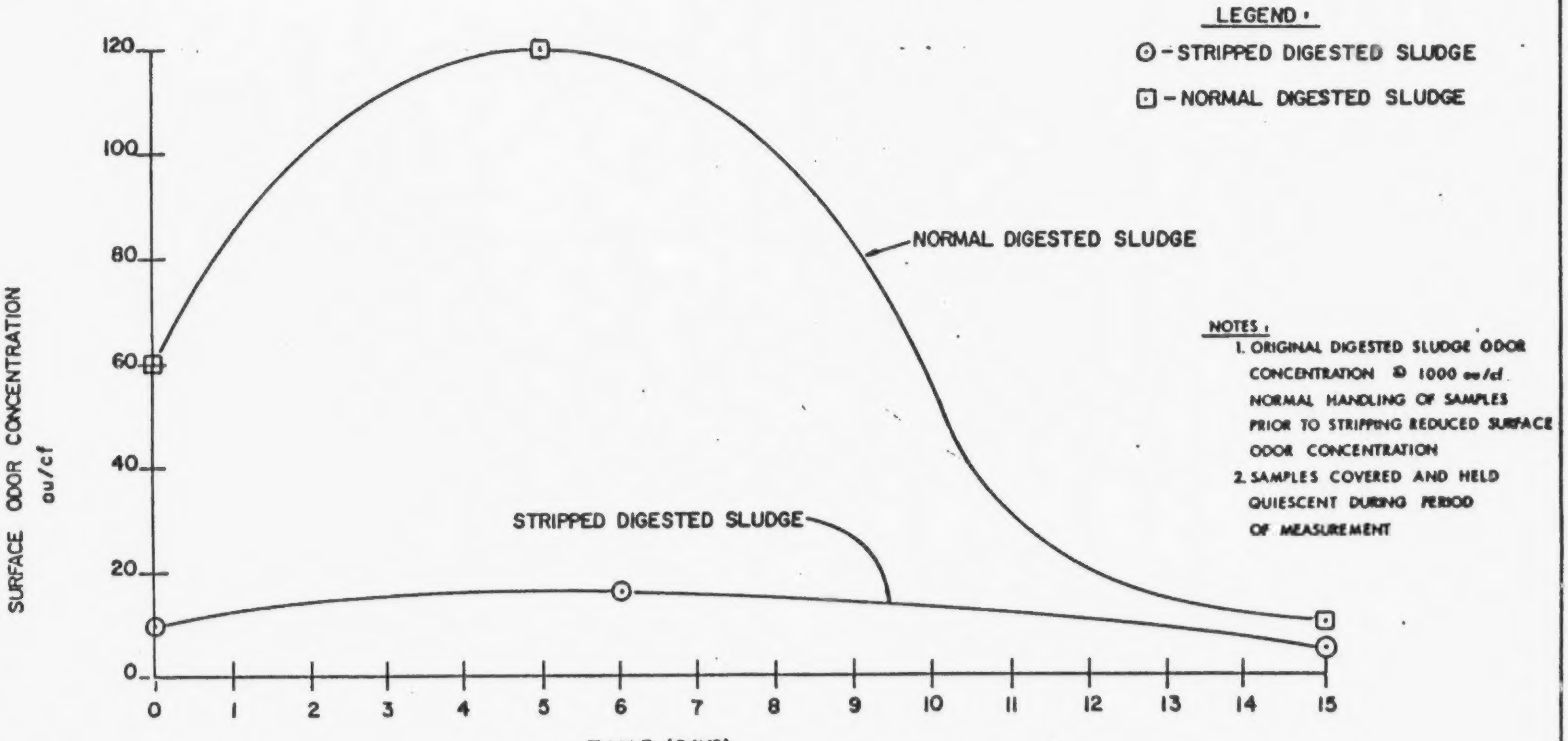
BACKGROUND

Both diurnal odor studies and odor complaint evaluations have been conducted at Sacramento County's Central Wastewater Treatment Plant in 1975. The objectives of these studies were to measure maximum odor emissions and to determine conditions under which maximum emissions and odor complaints occurred. Results of the odor complaint evaluations indicate that odors from the treatment plant and the uncontrolled SSB #3 and #4 are occasionally detectable beyond the plant boundary.

The land area covered by these solids storage basins will increase more than tenfold as the plant approaches ultimate 50-year design capacity. The effect of such an increase on downwind odor concentrations is unknown but it appears likely that odor complaint conditions will be much more common unless proper steps are taken to eliminate or reduce the likelihood of such occurrences.

Simultaneously with the odor studies, EUTEK undertook independent studies to determine the source of SSB odors. It appeared that the majority of the SSB odors entered with the digested sludge. No amount of odor appeared to be generated during the storage period.

Figure A-1 compares the odor concentrations above samples of air-stripped and normal digested sludge held at 65°F for several weeks. The samples were stored in closed containers and the air space was periodically monitored for its odor concentration.



NOTES:
1. ORIGINAL DIGESTED SLUDGE ODOR CONCENTRATION ≈ 1000 ou/cf. NORMAL HANDLING OF SAMPLES PRIOR TO STRIPPING REDUCED SURFACE ODOR CONCENTRATION
2. SAMPLES COVERED AND HELD QUIESCENT DURING PERIOD OF MEASUREMENT

FIG A-1 ODOR CHARACTERISTICS OF STRIPPED AND NORMAL DIGESTED SLUDGE

The significant observation to be drawn from these results is that the odorant can apparently be stripped from digested sludge. Furthermore, it appears that the odorant is not regenerated during storage at ambient temperatures. The magnitude of reduction in odor concentration appears to be sufficient to maintain downwind odor concentrations within the desired level.

STATEMENT OF NEED

Laboratory and bench scale studies have indicated that the chemical specie(s) responsible for the odor can be sufficiently stripped from digested sludge such that projected odor concentrations downwind from the SSB system will meet the odor control criteria. Verification of these findings is necessary to establish the feasibility of odorant stripping for reduction of downwind odor concentrations under long term storage conditions.

It is recommended that the feasibility of odor stripping be investigated initially in a pilot scale SSB and stripper.

TECHNICAL DISCUSSION

Odor Stripping

Several substances produced under anaerobic conditions have been identified as those normally responsible for offensive odors in wastewater treatment systems. (1,2) It is likely that these are the substances responsible for the odors emitting from the SSBs. These substances may be broadly classified as either inorganic gases or organic vapors.

Malodorous inorganic gases include hydrogen sulfide (H_2S) and ammonia (NH_3). Malodorous organic vapors include methyl mercaptans, methyl sulfides, amines, skatoles and indoles.

It is feasible to remove substances by air stripping provided the partial pressure of the substance in the ambient air is very low and the substance exerts a significant vapor at the temperature involved (3). Vapor pressures of many of the malodorous substances found in wastewaters are shown in Fig. A-2 (4), in which the vapor pressure of all the substances indicated increases as temperature increases.

Prather (5) has used aeration to remove phenols and ammonia from an oil refinery wastewater. Sawyer and McCarty (3) mentioned an instance in which ethyl alcohol was removed from an industrial wastewater by aeration. Slichta and Culp (6) have described the use of air stripping to remove ammonia from sewage effluents in South Lake Tahoe, Nevada.

For most substances the rate of removal of volatilized substances increases at higher temperature and is pH dependent. For example, ammonia and amines are stripped more easily at a higher pH; and, hydrogen sulfide and methyl mercaptan are stripped more easily at a lower pH.

Odorant Removal Methods

The evaluation of three alternate methods of removing odorants from the air stream is proposed.

Water Scrubbing - Industrial applications of wet scrubbing devices are quite common. In this instance the treatment plant effluent is proposed to be the absorption media. This can be accomplished by spraying the plant effluent over the stripped malodorous gases. Malodorous substances that cause nuisance odors in the concentrated digested sludge may not

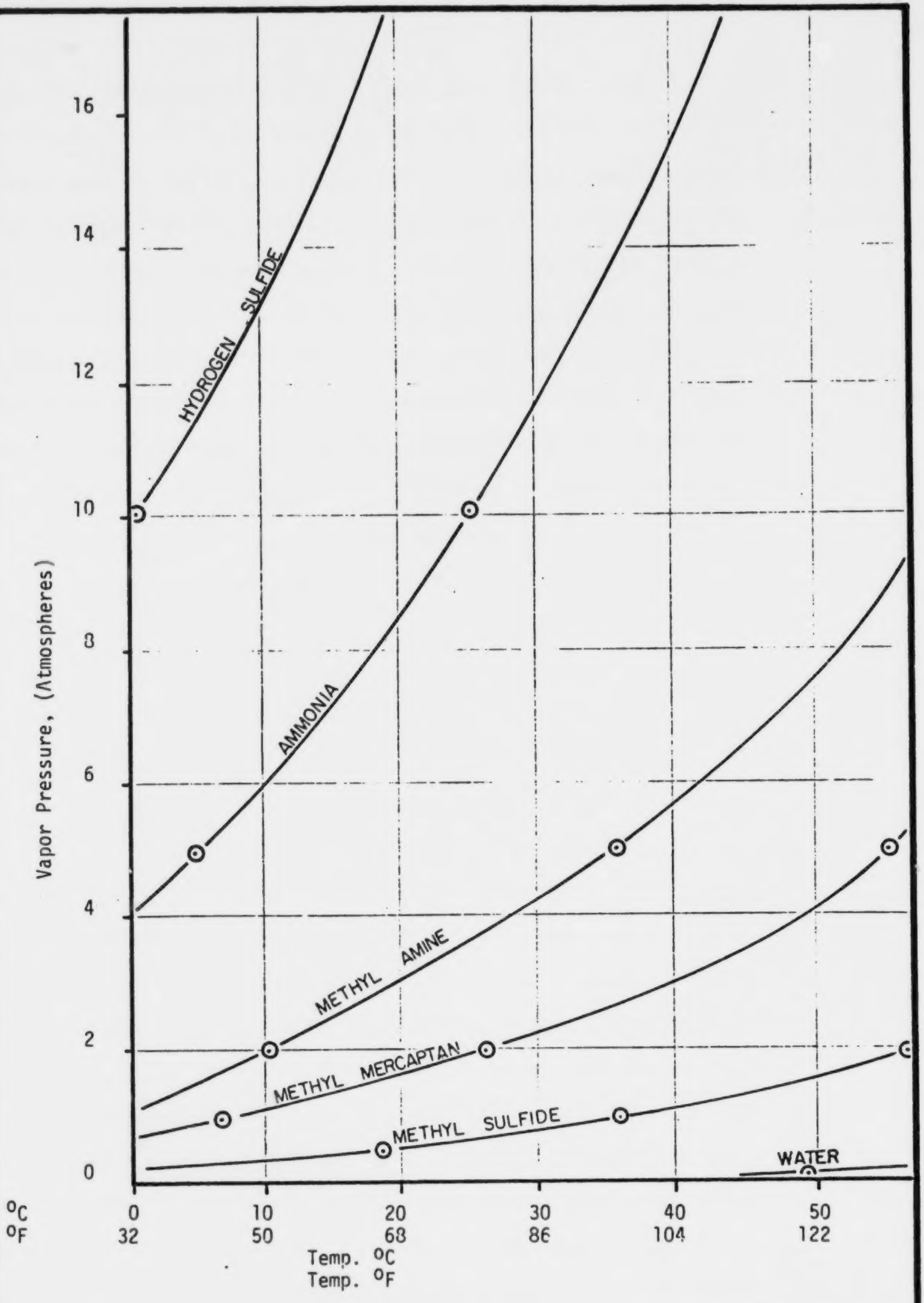


FIG. A·2 VAPOR PRESSURE OF CERTAIN MALODOROUS SUBSTANCES (4) cause similar problems when these substances are absorbed and diluted in the plant effluent. The rate of desorption of a gas from a liquid is proportional to the difference between the actual and equilibrium gas concentrations in that liquid. Therefore, dilute concentrations of these substances in the plant effluent need not cause an odor problem.

Reactive Chemical Scrubbing - Reactive chemical scrubbers have received extensive use in the chemical and wet process industry. Willoughby and Curnick (7) reported the successful application of hypochlorite scrubbing to digester off-gases. Chemical scrubbing removes malodorous substances from an air stream by absorption and oxidation. Principle regents used in reactive chemical scrubbers are:

1. hydrogen chloride (HCl)
2. hydrogen nitrate (HNO_3)
3. sodium hydroxide ($NaOH$)
4. sodium hypochlorite ($NaOCl$)
5. potassium permanganate ($KMnO_4$)
6. hydrogen peroxide (H_2O_2)
7. sodium persulfate (N_3HSO_4)

Carbon Filter - Adsorption on activated carbon is a practical method of handling waste ventilation air containing low concentration of odorous gases. Its use is relatively common in municipal wastewater treatment facilities and has been reported by a number of investigators (8-11).

However, because of its nonpolar hydrophobic surface, activated carbon adsorbs hydrocarbons in preference to water vapor and some other species in the air stream. The question has been raised that non-odorous hydrocarbons saturate the carbon bed in preference of other odorous compounds such as hydrogen sulfide (H_2S). With a result the removal efficiency of odorant substances by carbon adsorption is significantly reduced.

The extent of reduction in the removal efficiency of odorant material depends on the species and quantity of the hydrocarbons existing in the air stream from wastewater treatment facilities. Consequently, there is a need for quantitative evaluation of the economic impact of non-odorous hydrocarbons on carbon adsorption beds.

To date, no quantitative analysis of the chemical compositions of the gas emitted from the anaerobically digested sludge has been conducted. Gas chromatographic analysis of sludge air will determine the hydrocarbon concentrations and the concentrations of other substances present in the samples. By measuring both samples inlet to and outlet from a pilot carbon column, the amount of hydrocarbon as well as other odorous substance, which are adsorbed in the carbon bed, can be determined. In addition, an equilibrium adsorption isotherm for a particular type of carbon can be developed and be used as a basis of evaluation and full scale design.

An equilibrium adsorption isotherm shows the relationship between the amount of substance adsorbed and its concentration in the equilibrium gas stream out of the adsorption column, with all other variables such as pH, temperature, and other physical or chemical parameters held constant. Various theories have been proposed for the mathematical presentation of an adsorption isotherm. One empirical and useful expression, known as Freundlich isotherm, has been used successfully in water and wastewater treatment problems. It relates the amount of impurity absorbed to the solution as follows:

$$\frac{X}{M} = K\, C_e^{\frac{1}{n}}$$

where,

X = weight of adsorbed impurities, mass

M = weight of activated carbon, mass

C_e= concentration of impurities in the effluent air sample, conc.

K,n = empirical constants

An equilibrium adsorption isotherm can be produced in the laboratory by contacting the sludge air stream with various amounts of activated carbon for a sufficient period of time. Test results would provide information on the degree of removal that can be achieved by adsorption and an indication of the adsorptive capacity of the carbon.

PROJECT PROGRAM

OBJECTIVES

The proposed work plan objectives are as follows:

Phase I - Design and construct a pilot scale SSB system with pilot scale stripper, consisting of two parallel 2500 sq. ft. basins (one loaded with normal digested sludge and one loaded with air-stripped digested sludge).

Phase II - Monitor odor reduction by alternative stripping procedures and select the optimal procedure. Make preliminary design recommendations for full scale stripping system.

Phase III - Evaluate alternative methods of removing odorant from stripped air stream
- a) wet scrubbing
- b) reactive chemical scrubbing
- c) activated carbon adsorption

Phase IV - Monitor long term diurnal odor emissions from pilot SSBs and determine magnitude of reduction in downwind odor concentrations due to odorant stripping. Assess feasibility of odorant stripping for control of SSB downwind odors.

DESCRIPTION OF PROJECT PROGRAM

Phase I. Design and Construction of Pilot Scale Odor Stripper and SSB System

Figure A-3 is a flow diagram of the pilot SSB odor stripping system illustrating its primary features. The pilot scale system will be located east of SSB #1 as shown on Fig. A-4. Digested sludge pumped from the Central Treatment Plant would be transported from the 6" cross at the terminal end of the 6" line running between SSBs #1 and #2 to the elevated holding tank and air stripper at the location of the pilot SSBs. Approximately 2500 gallons of digested sludge would be transferred to this tank twice a week. A surplus 5000 gallon water storage tank provided by the Water Quality Division would suffice. Half of the digested sludge discharged to the holding tank would then be discharged to the westerly pilot SSB. The remaining digested sludge would be stripped and then discharged to the easterly pilot SSB.

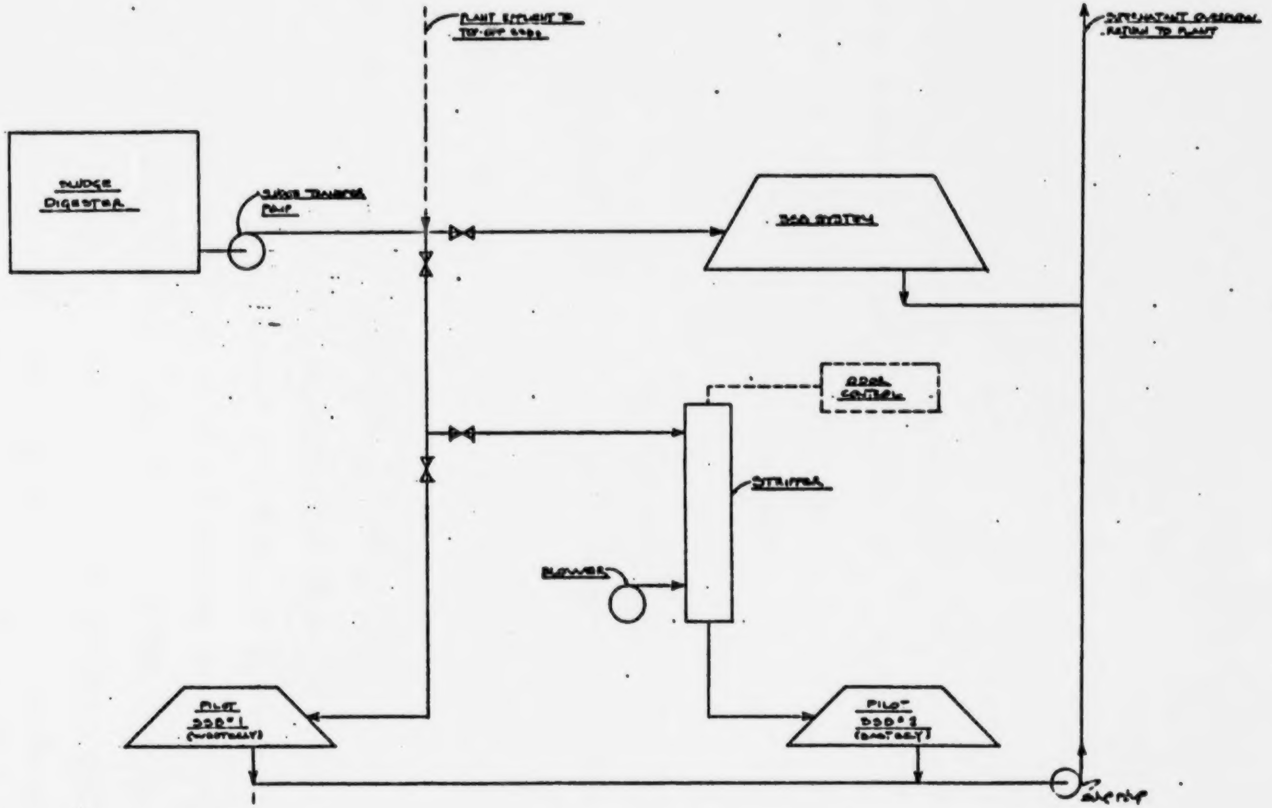


FIG. A3 FLOW DIAGRAM OF PILOT SSB ODOR STUDY

FLOW DIAGRAM
PILOT SSB ODOR STUDY

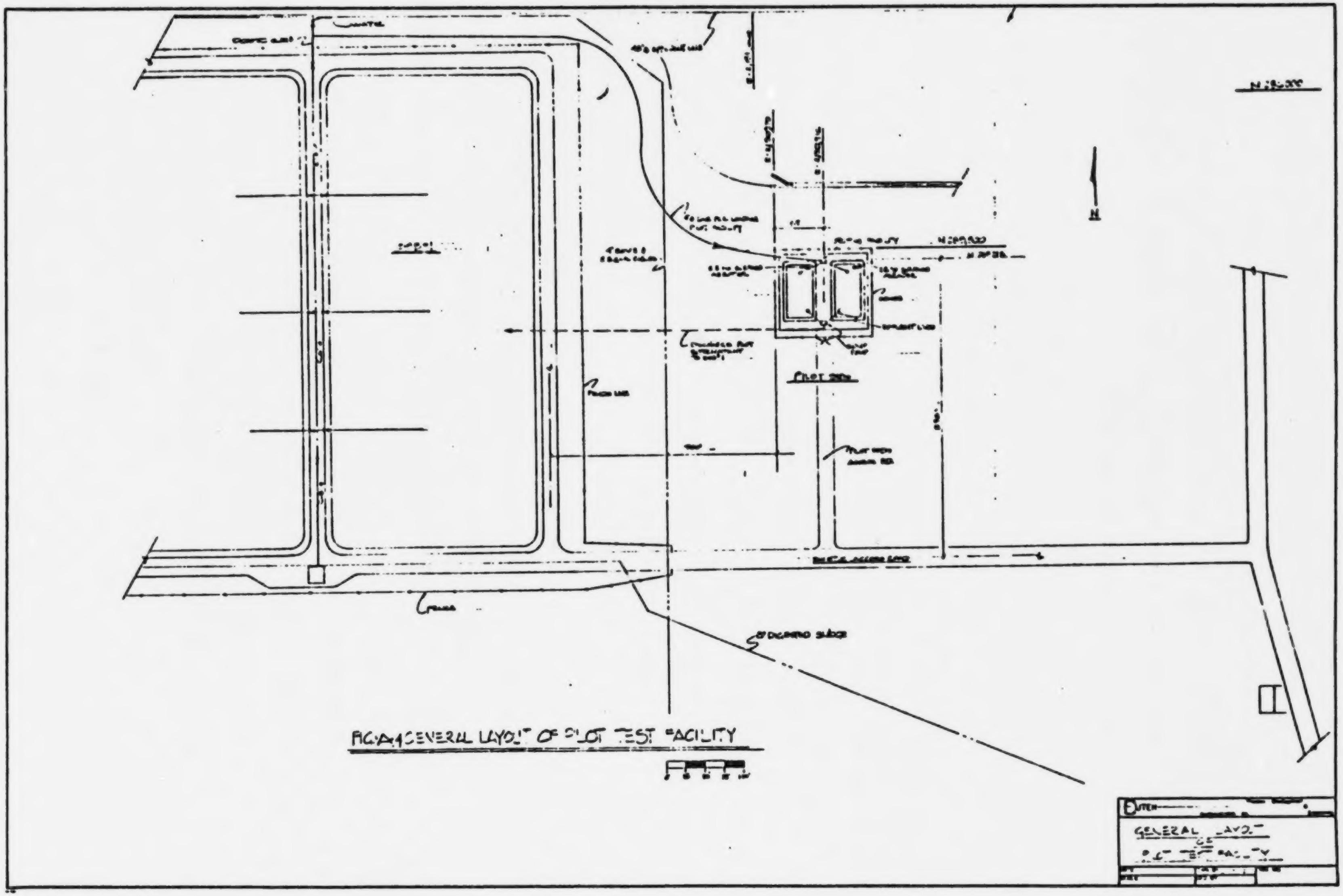


FIG. A-4 GENERAL LAYOUT OF PILOT TEST FACILITY

Initially the pilot SSBs would be topped-off with plant effluent provided through the existing line north of SSB #1. Following topping-off, the pilot SSBs would be operated similarly to the full scale SSBs. Overflows would be collected in a sump located in the southerly levee and would be pumped to the SSB #1.

Consideration should be given to the construction of the pilot scale system by Water Quality Division personnel. As illustrated on Fig. A-5 the pilot SSBs and the stripping facility are of simple design and could be constructed with the construction capabilities of the Water Quality Division.

The pilot system would be designed to operate automatically with manual overrides. Level controls in conjunction with pneumatically actuated diaphram valves would be employed to control the amounts of digested sludge loaded on each of the parallel SSBs. The optimal stripping procedure will be controlled using integrated circuit timers (ICTs). Discharge of supernatant overflow to SSB #1 would be controlled with level controls operated in conjunction with the sump pump.

Phase II. Monitoring Alternative Stripping Procedures

Background information on this work plan indicated that the odorant from the digested sludge appears to: 1) have a relatively low threshold odor concentration; 2) has an apparent vapor pressure which is strongly temperature dependent in the ambient temperature range; 3) has an enriched vapor phased concentration relative to its liquid phase concentration; and 4) can be air stripped. Accordingly, the efficiency of the odorant stripping process may be significantly improved by passing the

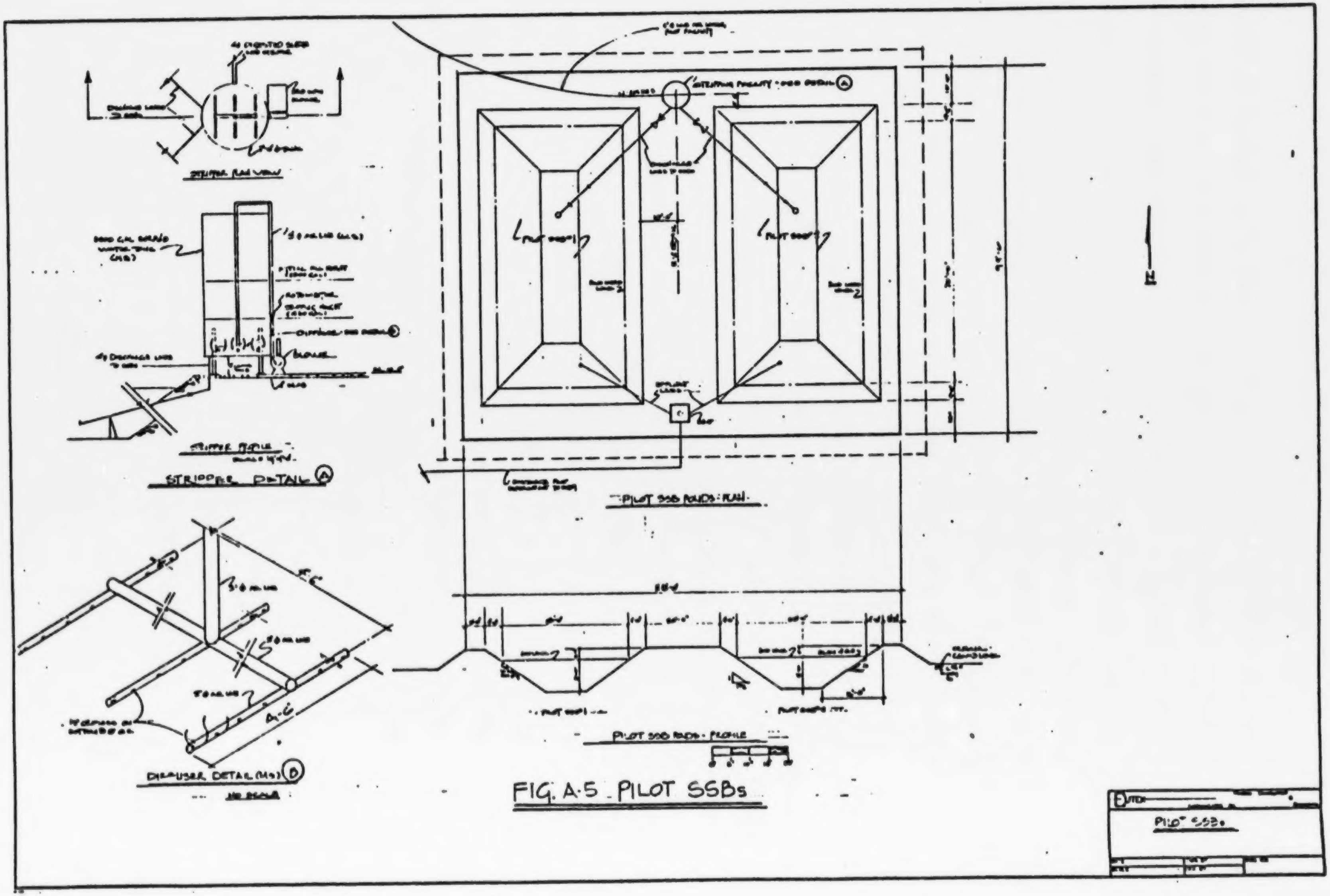


FIG. A-5 PILOT SSBs

warm digested sludge through a flash evaporation chamber at negative pressure and then air stripping the blow down from the flash evaporation step. Figure A-6 illustrates the manner in which such a process would be operated in a pilot scale operation. It is proposed to evaluate the effectiveness of flash evaporation at the pilot system site and to compare its efficiency with that of air stripping. The plant effluent line would be used as the source and sink for the motive liquid operating the educator evacuating the flash chamber. The pilot flash chamber will be designed and constructed by EUTEK.

Test runs would be made over a series of eight weeks with and without the flash evaporation step to determine its effectiveness in accelerating odorant stripping. An ICT would then be set up to automatically operate the stripping system according to the optimal procedure. A summary report will review evaluations of the stripping alternatives.

Phase III. Evaluation of Alternate Stripped Odorant Control Systems

Evaluation of the alternatives for control of stripped odorant(s) will be carried out on a bench scale basis. Bench scale units will be designed and constructed by EUTEK. The units will be operated in parallel with each receiving a known odorant loading. Odor control systems to be evaluated are:

1. water scrubbing(using plant effluent)
2. reactive chemical scrubbing
    a. acid
    b. base
3. Carbon adsorption

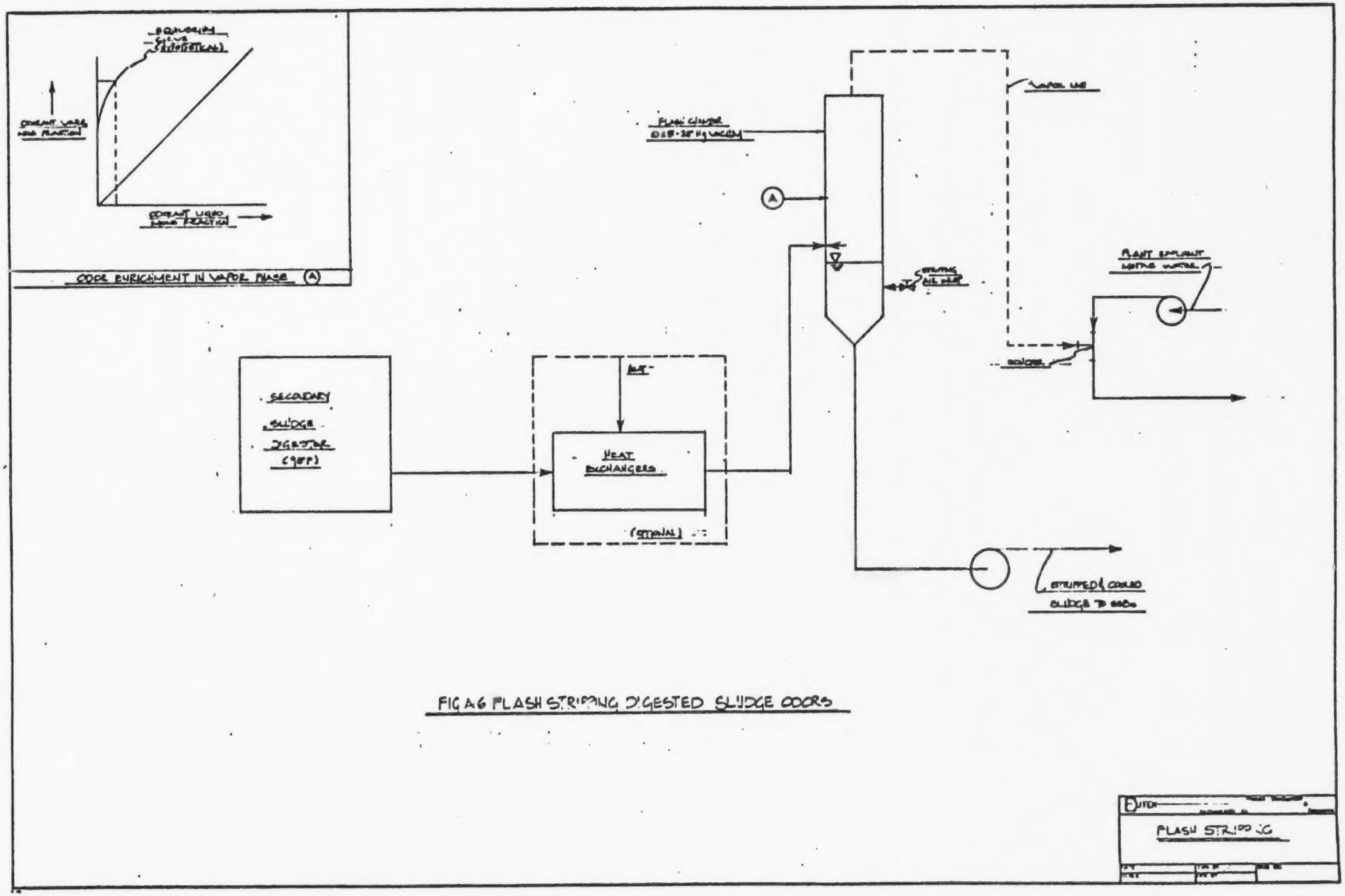

EQUILIBRIUM CURVE (HYPOTHETICAL)
ODORANT VAPOR MOLE FRACTION
ODORANT LIQUID MOLE FRACTION
ODOR ENRICHMENT IN VAPOR PHASE (A)
FLASH CHAMBER @25-28" Hg VACUUM
(A)
VAPOR LINE
STRIPPING AIR INLET
PLANT EFFLUENT MOTIVE WATER
EDUCTOR
SECONDARY SLUDGE DIGESTER (95°F)
AIR
HEAT EXCHANGERS
(OPTIONAL)
STRIPPED & COOLED SLUDGE TO DISP.
FLASH STRIPPING

FIG A6 FLASH STRIPPING DIGESTED SLUDGE ODORS

The bench scale odor control studies will be initiated following selection of the optimal stripping procedure. The alternative control systems will be monitored periodically during the course of the remaining study to evaluate their long term effectiveness in controlling stripped odorants. Following this monitoring program, preliminary design recommendations for a full scale stripper odor control facility will be made.

Phase IV. Monitoring Diurnal Odor Emissions

Odor emissions from the pilot SSBs will be monitored in twelve 8-hour study periods. Odor measurements will be made during the 8-hour period in which emissions are expected to be maximum, for example, from 3-11 p.m. These studies will ascertain if, under conditions of long term storage, the odor emissions from the SSB receiving stripped digested sludge are significantly less than the control SSB. Because of the reduced size of the pilot SSBs, downwind odor measurements will be conducted only at the downwind edge of the pilot SSBs. Other parameters monitored will include wind direction and velocity, air and water surface temperatures, and surface odor emission concentrations. The results of the equivalent four bi-monthly diurnal odor studies will be compared with the results of the long term diurnal odor monitoring program of SSB #1. Pilot study results will then be extrapolated to determine the effectiveness of digested sludge odorant stipping as a control measure in controlling downwind odor emissions from the full scale SSB system.

MONTHLY PROGRESS REPORTS AND FINAL REPORT

Written reports summarizing phase study results will be submitted monthly. Preliminary phase study reports will be submitted following completion of Phases II and III, respectively. The final work plan report will be submitted following the completion of the Phase IV study results, and the finding from this pilot scale evaluation will be used as basis for full scale odor stripping system.

ESTIMATED STUDY TIME AND COSTS

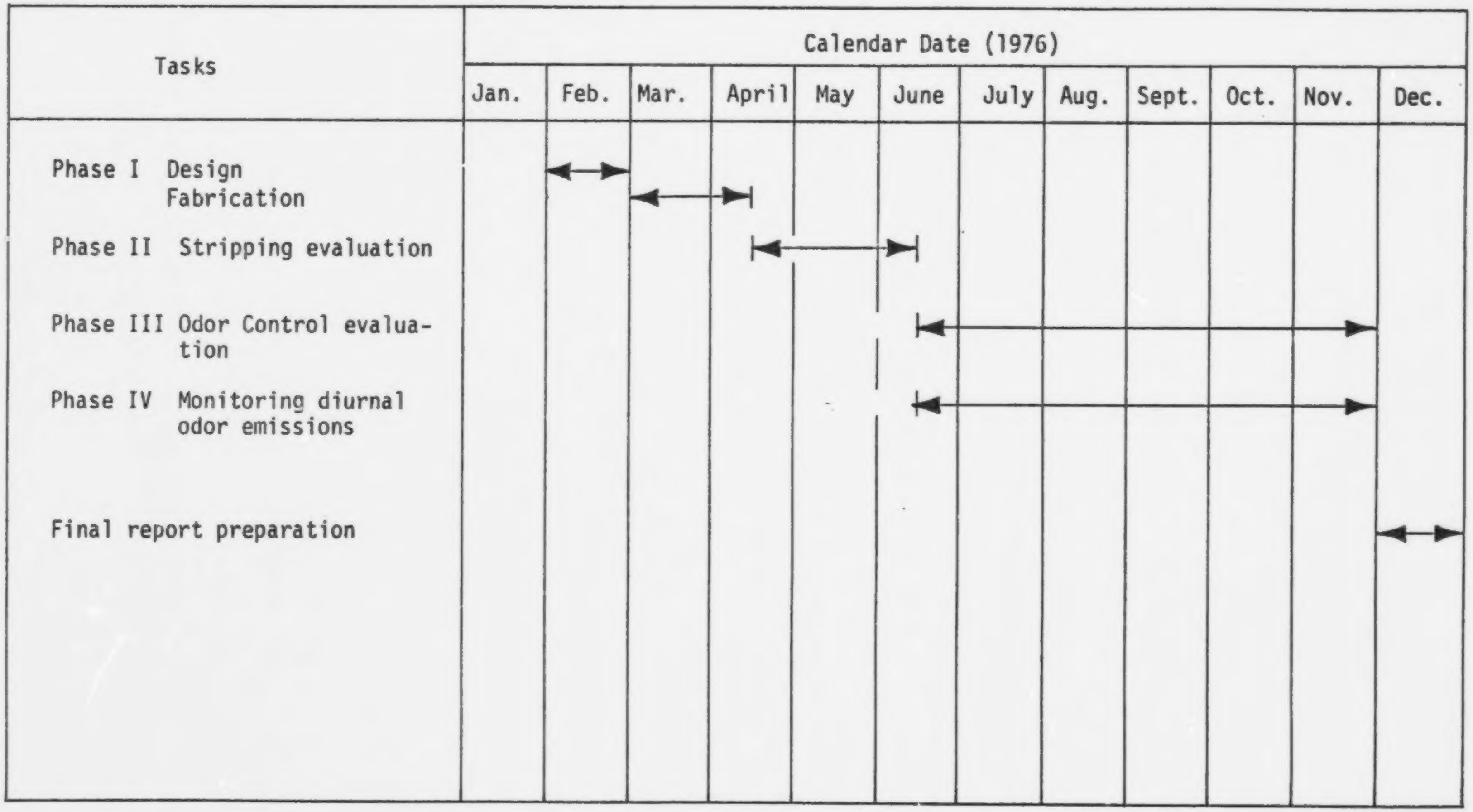
The time and costs for construction of the pilot SSB system will be subject to the availability of the required materials, equipment and personnel from the Water Quality Division. The estimated time and cost of providing the engineering services associated with the work plan phases are estimated as follows:

Phase		Estimated[1] Time (wk)		Estimated Cost ($)
I.	Design	3		$ 7,000
	Stripper material & fabrication (pilot scale SSB by Water Quality Division)	6		20,000
II.	Stripper Evaluation[2]	8		10,000
III.	Odor Control Evaluation[3]	22	concurrent	25,000
IV.	Diurnal Studies	22		20,000
	Final Report	4		10,000
		48		92,000

Notes:

1. Proposed scheduling of work in calendar year 1976 is shown in Fig. A-7.
2. Includes design and construction of pilot flash evaporator.
3. Includes design and construction of bench scale air stream odor control units.

Figure A-7. Stage 1 Pilot Scale Odor Stripping System Development



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APPENDIX B

Proposal of EUTEK
for
Evaluation of the Effect of Large Scale
Source Odor Emissions on Downwind
Odor Concentrations

(Work covered by this proposal is incorporated in Subtask 4.6)

APPENDIX B

PROPOSED WORK PLAN: EVALUATION OF THE EFFECT OF LARGE SCALE SOURCE ODOR EMISSIONS ON DOWNWIND ODOR CONCENTRATIONS

STATEMENT OF NEED

As the treatment plant approaches ultimate 50-year design capacity, the amount of SSB surface area will increase from the present 7.5 acres to about 273 acres. Presently there is no way of determining what effect this will have on downwind odor concentrations. Therefore, a study should be initiated to investigate the relationship between the large scale source odor emissions and their downwind odor concentrations. This relationship should, in particular, be investigated under the conditions which produce the maximum odor concentrations at downwind locations and during the season in which the majority of the odor complaints are received.

The existing proposed odor control criteria were originally developed based on Air Pollution Control Districts experience with well defined odor sources, such as stack source. There is, however, some question as to the adequacy of this criteria for prevention of odor complaints caused by odor source within wastewater treatment facilities. These reservations are primarily related to the source odor concentrations and source emission rate limitations. The situation is complicated by the fact that the source, such as SSBs, has no forced air convection but is distributed over an extremely large area. Up to date, no data is available to develop a realistic and meaningful odor control criteria specifically for large scale SSBs. However, this proposed study, coupled with the proposed stripping study (Appendix A) to reduce the magnitude of maximum odor emissions, can collect and assimilate the data for developing a meaningful set of odor control criteria for the SSB system. A continuation of odor complaint evaluation and reduction of climatological data from SSBs in 1976 (both are proposed to Sacramento County) will provide useful information for the development of odor control criteria. Consequently, the proposed criteria for the SSBs would have the ultimate objective of prevention of occurrence of nuisance odors.

DESCRIPTION OF WORK PLAN

The majority of the odor complaints at the vicinity of Sacramento County's Central Treatment Plant have been received during the months of September. Several possible explanations for this have been provided in the text of the final report of 1975 diurnal odor studies. One of the reasons is that the critical calm wind conditions, in which the "puff" transport mechanism prevails, are dominant during this period. Therefore, it is proposed to conduct this investigation in the months of August, September and October when conditions are similar to those in which the majority of the odor complaints were received.

Diurnal studies conducted in the past one and one-half years have shown that maximum odor concentrations usually occur during certain periods of the day. Periods often associated with maximum odor emissions are:

1. During and soon after SSB loading
2. During and after sunset

Therefore, rather than monitor downwind odor concentrations over a 24-hour period, it is proposed to monitor them over a critical 8-hour period; for example, from 3:00 p.m. to 11:00 p.m.

Diurnal studies have also identified the climatological conditions which produce maximum downwind odor concentrations. These conditions are:

1. Wind speed between 3 and 6 mph
2. Period of little lateral dispersion
3. Calm to no wind conditions which "puff" transport mechanism prevails

Consequently, the specific climatological conditions which are proposed to investigate are identified below:

1. Stable to calm wind conditions, no artificial wind source.
2. Stable wind conditions, artificially induced 3 mph wind.
3. Moderate wind conditions, artificially induced 6 mph wind.

There exists a limitation in predicting the probable effect of large scale source odor emissions on downwind odor concentrations when the predicting model available is only one-tenth the size of the full scale SSB. An assumption has to be made with regard to the surface odor emissions at the testing model such that the surface odor emission rates can be simulated closely to the full scale. The highest surface odor emission measured in the past diurnal odor studies was about 200 ou/cf. Assuming the worst condition happens to the full scale SSBs, that is, the surface odor emission in each of the 44 SSBs (50-year design capacity) is 200 ou/cf, the simulates' surface odor emission from the model scale of one-tenth size should be 500 ou/cf. This reasoning has been based on the assumption of linear relationship. This assumption will be tested and evaluated in the initial stage of study, and, if another relationship exists between small scale and large scale surface odor emissions, a proper adjustment on the simulates surface odor emissions will be made.

It is proposed that this work plan proceed in three phases:

Phase I. High Intensity Artificial Source Odor Measurements on Single SSB

Figure B-1 illustrates the proposed plan for applying a high intensity, pleasant-smelling artificial odor source to the surface of a single SSB, basin #1. The artificial odor source will be applied in a sufficient quantity to provide a surface odor concentration of about 500 ou/cf. In addition, the quantity of odorant should be such that the odorant will be completely evaporated in about 10 hours.

One or more artificial wind source(s) will be positioned between SSBs #1 and #2 as located in the figure. Artificial wind can be induced by the wind machine. Based on the initial inquiry, a mobile machine, which is equipped with a 145 hp motor and is capable of producing a maximum wind velocity of 70 mph over a 10-acre area, can be leased at a cost of $1,500 annually. Depending on the conditions, several such machines may be required to produce the desired wind conditions.

Downwind odor concentration measurements will be made at several locations simultaneously, for example, 0, 50, 300 and 1000 feet along the apparent wind centerline, and at the same downwind distances right and left 100 feet of the apparent centerline. This manner of downwind odor measurements would investigate the "nature" of the "puff" transport mechanism such that a control measure might be able to be developed.

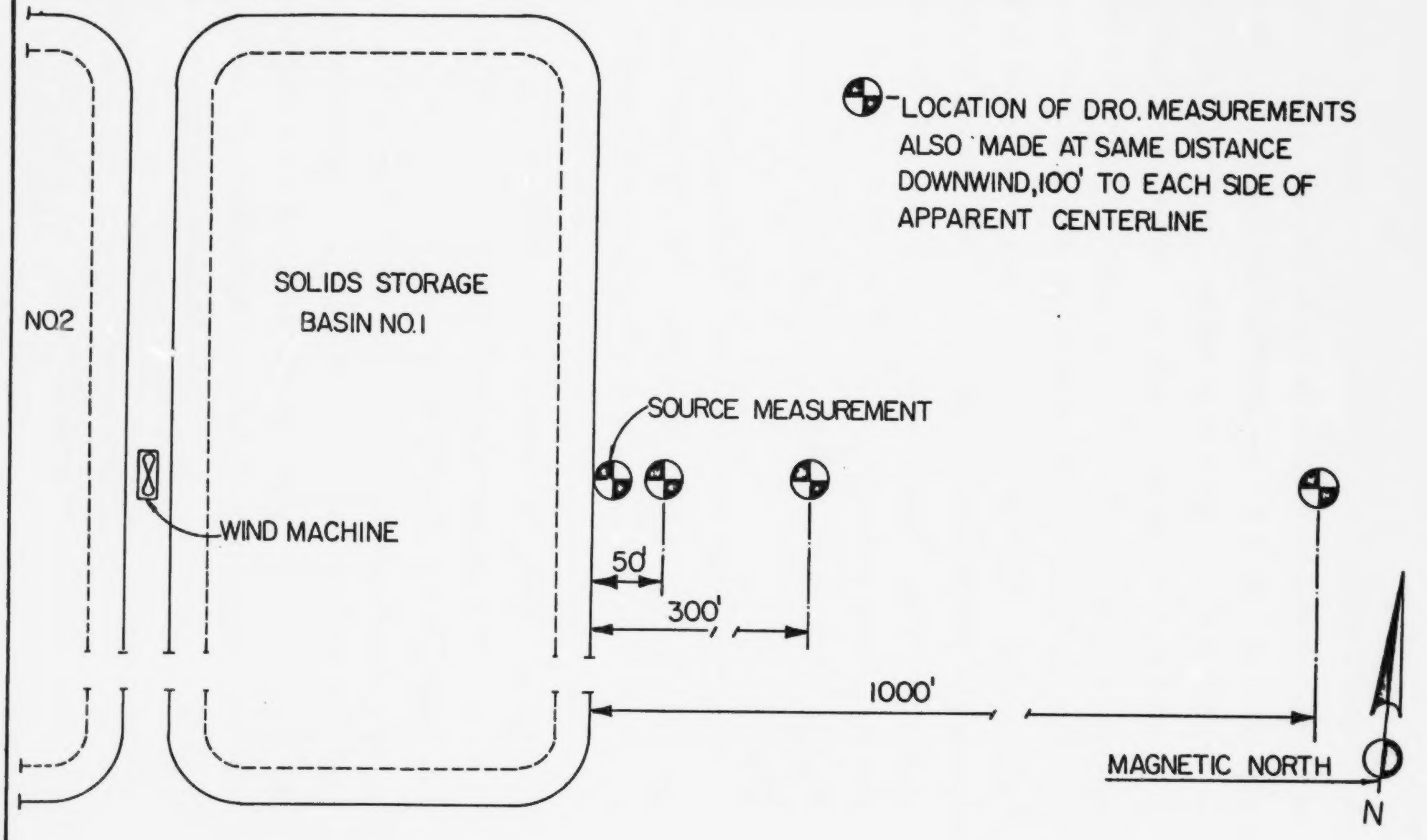

LOCATION OF DRO. MEASUREMENTS ALSO MADE AT SAME DISTANCE DOWNWIND, 100' TO EACH SIDE OF APPARENT CENTERLINE
SOLIDS STORAGE BASIN NO.1
NO.2
WIND MACHINE
SOURCE MEASUREMENT
50'
300'
1000'
MAGNETIC NORTH
N

FIG.B-1 MEASUREMENT OF ODOR DECAY AND DISPERSION FROM A SINGLE SOURCE

Figure B-2 shows the proposed odor monitoring program at various wind conditions. A total of four odor monitoring programs, each including three 8-hour periods, i.e., same period of the time of a day, are proposed. In each 8-hour period, odors will be monitored under one of the three wind conditions as indicated in Figure B-2. Consequently, four 8-hour odor monitoring periods will be under one similar, if not identical, wind condition such that data collected would provide a statistically valid interpretation. Since there are four DRO crews measuring simultaneously surface odor emissions and downwind odors at three downwind locations, an equivalent of sixteen 24-hour diurnal odor studies will be conducted during this phase of the work plan.

Phase II. High Intensity Artifical Source Odor Measurements on Multiple SSBs.

Figure B-3 illustrates the proposed plan for applying the artificial odor source to all the four existing SSBs. The artificial wind source(s) will be located at the west edge of the SSB No. 4 and to simulate the desired wind conditions under which odors will be monitored.

The same quantity of artificial odor source as applied to SSB No. 1 in Phase I will be applied to each of the four basins, creating a surface odor concentration of about 500 ou/cf in each individual basin. Therefore, any odor measurements at downwind locations, for example, 50', 300', and 1000' from the east edge of SSB No. 1 as shown in Figure B-3, will indicate the resulting downwind odors from the large scale and multiple odor sources. Again four DRO crews will be stationed simultaneously at various downwind locations to measure the odor concentrations such that donwind odors transported by "puff" mechanism can be evaluated.

Fig. B-2 Proposed Odor Monitoring at Various Wind Conditions

Odor Monitoring Program*		Specific Wind Conditions Proposed to Investigate		
		Stable to Calm Wind Conditions	Artificially Induced 3mph	Artificially Induced 6mph
1	8-hr	X		
	8-hr		X	
	8-hr			X
2	8-hr	X		
	8-hr		X	
	8-hr			X
3	8-hr	X		
	8-hr		X	
	8-hr			X
4	8-hr	X		
	8-hr		X	
	8-hr			X

* Four DRO crews measuring simultaneously surface odor emissions and downwind odors at three downwind locations

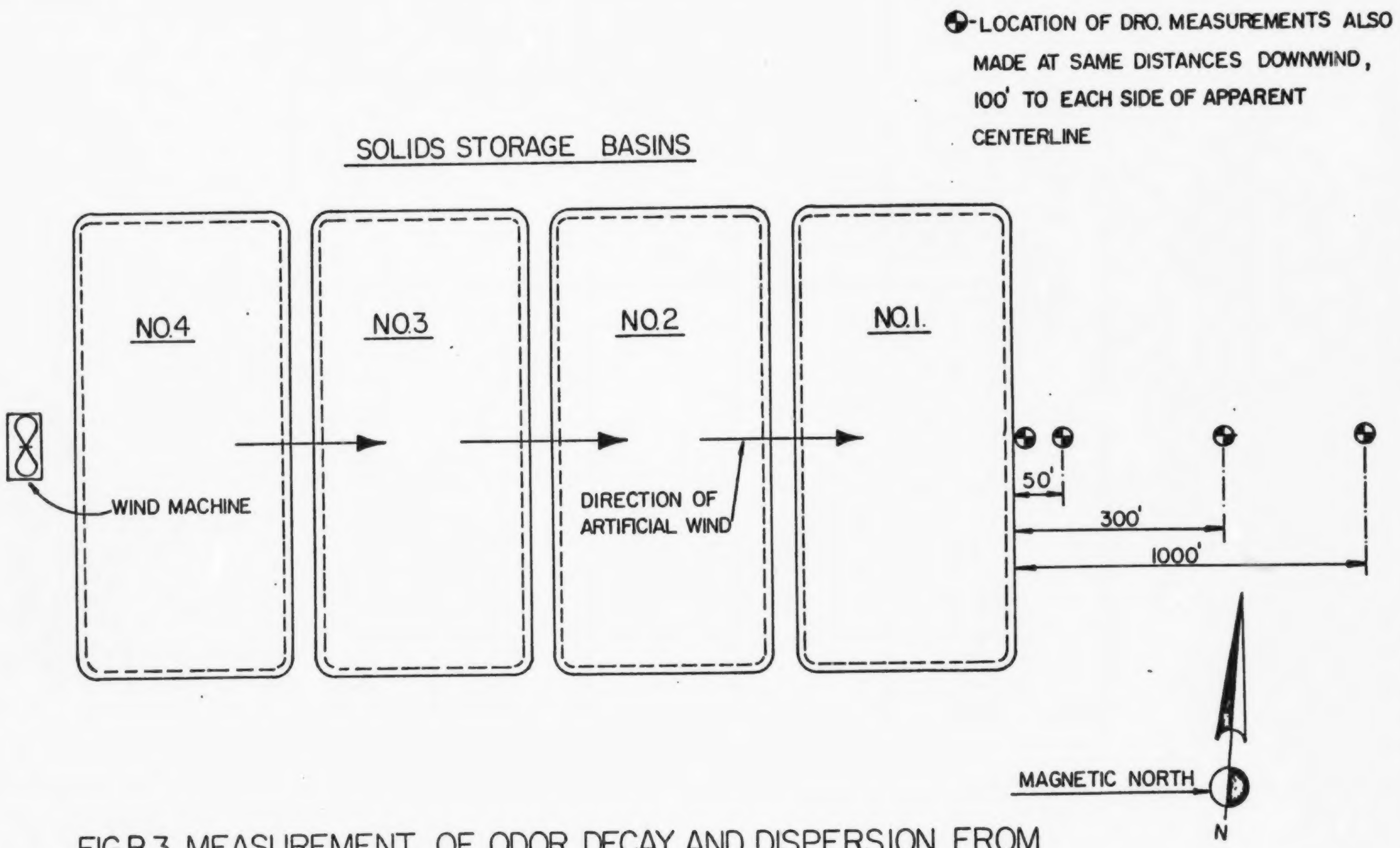

-LOCATION OF DRO. MEASUREMENTS ALSO MADE AT SAME DISTANCES DOWNWIND, 100' TO EACH SIDE OF APPARENT CENTERLINE
SOLIDS STORAGE BASINS
NO.4
NO.3
NO.2
NO.1.
WIND MACHINE
DIRECTION OF ARTIFICIAL WIND
50'
300'
1000'
MAGNETIC NORTH
N

FIG.B-3 MEASUREMENT OF ODOR DECAY AND DISPERSION FROM MULTIPLE SOURCES

The odor monitoring program proposed in the phase will be the same as those included in Figure B-2, the same schedule and wind conditions under which odors are to be monitored. The only difference is that there are four identical odor sources in Phase II versus one odor source in Phase I. Again, since there are four DRO crews measuring the surface odors and downwind odors simultaneously, an equivalent of sixteen 24-hour odor studies will be conducted during this phase of work plan.

Phase III. Result Interpretation and Final Report Preparation

The results of Phases I and II of this work plan will be analyzed to obtain relationship between maximum downwind odor concentrations and 1) climatological conditions; 2) downwind distance; 3) SSB surface area over which the wind has traveled; and, 4) surface odor concentrations. Based on the extent of impact on downwind odor concentrations due to the four-fold increases in odor emitting surface area, an extrapolation will be made to determine the probable impact on downwind odor concentrations when the odor emitting surface area increased ten-fold (50-year design capacity). An assessment will be made with regard to the conditions which would be likely to result in odor complaints.

Coupling the results from both the odor stripping study and the continued odor complaint evaluation, the data, which will be collected and assimilated in this work plan, will be used in the development of meaningful odor control criteria for the SSB system. The proposed odor control criteria would have as its ultimate objective the prevention of occurrence of nuisance odors or odors resulting in complaints.

MONTHLY PROGRESS REPORTS AND FINAL REPORT

Written reports summarizing the phase study results will be submitted monthly. Preliminary phase study reports will be submitted following completion of the Phase I and Phase II studies, respectively. The final report will be submitted once the analysis and interpretation of the results is complete.

ESTIMATED STUDY TIME AND COSTS

	Phase	Estimated[1] Time Required (wks)		Estimated Cost($)
I.	Artificial Source Measurements on Single SSB	12	Concurrent	$ 60,000
II.	Artificial Source Measurements on Multiple SSBs	12		60,000
	Data Analysis and Report Writing	4		10,000
				$130,000

(1) The work schedule is shown in Figure B-4.

Figure B-4 Investigation of Additive Multiple Source Odor Emission

Task	Calendar Date (1976)											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Phase I Four diurnal* studies from a single source								◄—	—	—►		
Phase II Four diurnal* studies from large scale sources								◄—	—	—►		
Phase III Result interpretation and report preparation											◄—►	

* Total 12 of 8-hr. study period

REVISED WORK PLAN AND PROPOSAL

SEWAGE SLUDGE MANAGEMENT PROGRAM

December 10, 1976

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

December 10, 1976

Mr. Brian H. Richter
District Engineer
Sacramento Regional County
Sanitation District
827 Seventh Street
Sacramento, California 95814

PROPOSAL FOR CONDUCT OF THE SEWAGE SLUDGE MANAGEMENT PROGRAM, SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM

Sacramento Area Consultants hereby proposes to provide the engineering services necessary for completion of the Sewage Sludge Management Program (SSMP). The work required is as outlined in the "Revised Work Plan and Proposal, Sewage Sludge Management Program", dated February 17, 1976 with the modifications noted herein. The program has been initiated on an interim basis under SAC Job Authorization J222 for which the latest authorized extension is dated October 21, 1976. As indicated in your request for proposal dated November 29, 1976, the SSMP must be converted to a Cost Plus Fixed Fee (CPFF) contract. The proposal covers all work to be conducted on or after November 1, 1976. Costs for work conducted prior to November 1, 1976, under a series of interim authorizations, are not included in this proposal; however, these costs are summarized in Section 3 of the proposal in order to indicate the total cost of the program.

The proposed work plan reflects the review made by the District staff and the State Water Resources Control Board. One major addition to the February 17, 1976 Work Plan is the inclusion of work to complete the necessary environmental impact reports. The work included in the SSMP is further described in the attachments and is to be performed by SAC and the designated subcontractors. SAC will furnish overall management services for all aspects of the project. The proposal is divided into the following sections:

1. A description of the updated scope of work including a Work Plan for the environmental impact reports for the solids storage basins and for the dedicated land disposal program.

2. A description of the contractual arrangement for conduct of this work.

3. A composite EPA Form 5700-41 for all services conducted on a CPFF basis. This section also includes a breakdown of cost by subtask. Costs covered by the proposal as well as costs incurred prior to November 1, 1976 are tabulated.

4. A detailed breakdown of the costs for all work to be performed directly by Sacramento Area Consultants.

5. Proposals from the three major subcontractors: EUTEK, Inc.; Spray Waste, Inc.; and Dwight C. Baier, Agricultural Consultant, are included in Sections 5 through 7. An EPA Form 5700-41 and breakdown of direct and indirect costs are provided by each of these subcontractors.

All work will be conducted in accordance with and upon execution of Amendment XI of the SAC/District "Agreement for Engineering Services". Until the contract amendment is executed, work on the Sewage Sludge Management Program will continue in accordance with the latest interim authorization. The total price for work to be conducted under this proposal is $1,421,975.18. Costs billed to the District in invoices up through October 1976 covered by the interim J222 authorization were about $411,000, bringing the current total cost estimate of Sewage Sludge Management Program to about $1,833,000.

We appreciate the opportunity to continue work on the Sewage Sludge Management Program and look forward to successful completion of the project.

SACRAMENTO AREA CONSULTANTS

Lyle N Hoag

Lyle N. Hoag
General Manager

LNH:JES:jf

SEWAGE SLUDGE MANAGEMENT PROGRAM PROPOSAL

List of Attachments

Section

1 Scope and Schedule of Engineering Services
  - Attachment A - EIR Work Plan
  - Attachment D - Response to March 3, 1976 Letter

2 Contractual Arrangements

3 Summary of Proposal Price
  - Table 3 - Cost Summary
  - EPA Form 5700-41
  - Attachment A - SAC Direct Labor Rates
  - Attachment B - Direct Cost Summary
  - Attachment C - Profit Calculation

4 SAC Proposal
  - EPA Form 5700-41
  - Attachment A - Direct Labor Summary
  - Attachment B - Travel Costs
  - Attachment C - Other Direct Costs
  - Attachment D - Subcontract Costs

5 Dwight C. Baier Proposal
  - EPA Form 5700-41
  - Attachment A - Hourly Rates
  - Attachment B - Overhead Percentages
  - Attachment C - Manhour Summary
  - Attachment D - Travel Costs
  - Attachment E - Equipment Costs
  - Attachment F - Sampling Schedule
  - Attachment G - Subcontract Costs

6 Spray Waste, Inc. Proposal
  - EPA Form 5700-41 for Subtask 6.1
  - Attachment A - Direct Labor Costs
  - Exhibit A1 - Overhead Summary
  - Exhibit A2 - Overhead Description
  - Exhibit A3 - Fee Schedule
  - Attachment C - Sampling Schedule
  - EPA Form 5700-41 for Subtask 6.2
  - Attachment A - Direct Labor Costs
  - Attachment B - Travel Costs
  - Attachment C - Sampling Schedule

SEWAGE SLUDGE MANAGEMENT PROGRAM PROPOSAL

List of Attachments
(continued)

Section

7 EUTEK, Inc. Proposal
- Exhibit A - EPA Form 5700-41
- Exhibit B - Hourly Rate Schedule
- Exhibit C - Hourly Rate Extension
- Exhibit D - Task Description
- Exhibit E - Labor Requirements
- Exhibit F - Indirect Cost Summary
- Exhibit G - Indirect Cost Accumulations
- Exhibit H - Other Direct Costs
- Exhibit I - Costs by Subtask

SECTION 1

SCOPE AND SCHEDULE OF ENGINEERING SERVICES FOR THE SEWAGE SLUDGE MANAGEMENT PROGRAM

SCOPE AND SCHEDULE OF ENGINEERING SERVICES FOR THE SEWAGE SLUDGE MANAGEMENT PROGRAM

In conformance with your request for proposal of November 29, 1976, this proposal for the Sewage Sludge Management Program (SSMP) covers work to be conducted on or after November 1, 1976. Cost for work which was conducted prior to November 1, 1976, but was not billed to the District in the invoices up through October 1976, is also included in this proposal. We have presented a summary of the costs incurred by the District for the SSMP prior to November 1, 1976 (Table 3 in Section 3) in order to indicate the total cost of the program. Engineering services will be provided for the Sewage Sludge Management Program as described in the "Revised Work Plan and Proposal - Sewage Sludge Management Program (J222) - February 17, 1976" with certain modifications noted in this proposal. Since the February 17, 1976 submittal, the following actions have resulted in significant modifications to the work plan:

1. SWRCB letter of May 17, 1976 approving the work plan with conditions.
2. June 3, 1976 meeting with SWRCB, CVRWQCB, and State Health Department staffs.
3. September 30, 1976 meeting with SWRCB staff.
4. J222 interim authorization extensions 1 through 7.

Modifications Based on State Review

The State Board approval letter of May 17, 1976 raised several questions regarding the proposed scope of work. The State letter recommended that the sludge spreading program be reduced from four years to three years. This proposal incorporates that suggested change to the spreading program. Sludge injection was tested in 1976. Furrow and flooding alternatives will be tested in 1977 and the best disposal method will be repeated in 1978. The monitoring program will be similarly modified. Monitoring of the dedicated land disposal site will be scheduled to effectively monitor the impacts of each of the alternative spreading methods. Therefore, monitoring will be conducted through the end of May 1979 to collect data during the wet weather period following the 1978 spreading operation. The monitoring work previously scheduled for the latter part of 1979 has been eliminated. In this proposal the parameters to be tested and frequency of sampling for disposal site monitoring are essentially the same as set forth in the February 1976 work plan. This level of monitoring effort was questioned in the State letter of May 17, 1976, but was subsequently discussed at a meeting on June 3, 1976 attended by State Board, Regional Board, and State Health Department staff and deemed to be necessary for an adequate evaluation of the dedicated land disposal concept.

The State Board letter of May 17, 1976 indicated that an environmental impact report (EIR) would be required to cover the Sewage Sludge Management Program. This proposal incorporates the EIR work. As discussed with District and State Board staff at the meeting on September 30, 1976, because of certain time constraints two separate EIRs will be prepared. The first EIR will deal with the solids storage basins and alternatives for sludge treatment. The second EIR will evaluate dedicated land disposal and other sludge disposal alternatives. In each case the EIR process will result in selection of a project for which Step 2 authorization will be sought.

The need for the dual EIR approach is necessitated by the fact that if the solids storage basin concept is rejected, an alternative system must be designed and constructed by the time the Regional Plant goes on line. Design of an alternative system would have to be initiated by July 1978 and thus, the draft EIR must be essentially completed by the end of 1977 to allow for final EIR adoption by July 1978. Since the monitoring program for the dedicated land disposal program will not be completed until May of 1979 (see Figure 1), it is not possible to incorporate a complete evaluation of dedicated land disposal within the time frame of the first EIR. It is therefore proposed to begin the second EIR in mid-1979 at which time all monitoring data will be available. Work plans and schedules for the two EIRs are provided in Attachment A included in this section of the proposal. Manhour requirements and costs are detailed in section 4 of the proposal.

The third area of major concern expressed in the State Board letter of May 17, 1976 deals with the need for microbiological and virus studies. As discussed with staff from the pertinent State regulatory agencies at the June 3, 1976 meeting, the proposed microbiological and virus studies are essential to providing assurance that state standards for protecting public health can be met during storage, conveyance, application, and final disposal of the sewage sludge. It is intended to make use of microbiological and virus data previously collected from other sludge studies in California, whenever possible. Monitoring work associated with the solids storage basins which had been scheduled during 1978 and early 1979 has been deleted from the program. It is felt that sufficient data will be gathered by the end of 1977 for alternative evaluation in the SSB EIR. Otherwise, the scope of microbiological and virus work as outlined in the February 1976 work plan has been incorporated into this proposal.

Modifications Made During Interim Authorization Period

The Sewage Sludge Management Program has been initiated on the basis of a series of interim authorization extensions. The latest interim extension authorizes work to be conducted for the period of October 1, 1976 through December 31, 1976. The interim work authorizations have been based on the February 1976 work plan. It was felt that a step-by-step interim authorization approach was necessary to allow time to finalize the overall scope of the program and to convert the on-going engineering services to a contract amendment in accordance with Amendments VI and VII of the District/SAC Agreement.

Over the course of the interim authorization period, certain modifications have been made to the scope of work as outlined in the February 1976 work plan. Those modifications that have affected the cost of the program are listed in Table 1. In total these modifications have resulted in an increase of the SSMP cost of $138,200.

Response to District's March 3, 1976 Letter

Attachment B provides responses to the District's comments on the February 1976 Work Plan made in a letter of March 3, 1976. These responses reflect the subsequent program modifications discussed earlier in this section.

TABLE 1

MODIFICATIONS DURING INTERIM AUTHORIZATION PERIOD
SEWAGE SLUDGE MANAGEMENT PROGRAM

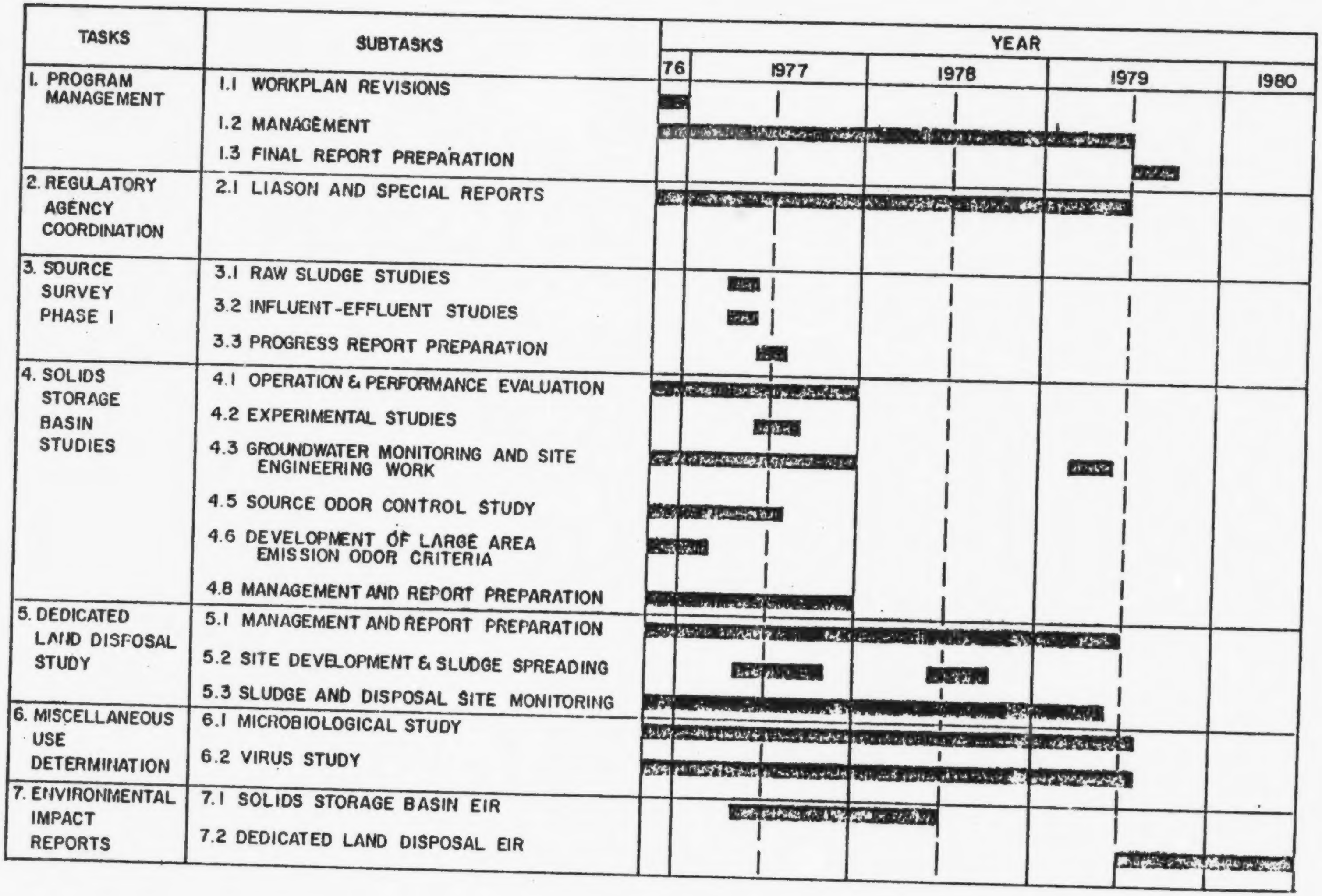
Auth. Ext.	Date	Task	Description of Modification	Cost ($)
3	3/23	1.1	Preparation of additional background data on development of SSMP	8,000(S)
5	5/27	1.1	Work plan revisions based on SWRCB review	4,500(S)
		4.5	Revision of SSB pilot scale odor facility costs	32,000(E)
6	8/5	4.3	Additional soil solution work caused by delay in getting SSBs 5 and 6 in service	3,500(E)
		4.5	At suggestion of EPA, rotostrainer added to evaluate removal of floatables from sludge	8,000(S)
		4.5	Additional equipment, construction and testing costs for pilot odor facility	23,000(E)
		4.5	Additional construction supervision cost for pilot odor facility	8,000(E)
		4.6	Additional cost for starting portion of large area odor emission study previously scheduled for 1977	600(E)
7	10/21	4.5	Addition of manual override controls for automatic control system	1,000(S)
		4.5	Expansion of odor stripping evaluation period to determine variability of digested sludge odor levels	30,000(S)
		4.5	Facility modification necessary to evaluate odor stripping staging requirements	6,500(S)
		4.5	Additional cost for surface mixers for pilot SSBs	4,000(E)
		4.5	Clearing 1975 sludge from pilot SSB	1,200(E)
		4.5	Revised construction cost for pilot odor facility based on final time and expense accounting	6,800(E)
		4.6	Modifications to meteorological monitoring equipment	1,100(S)
			TOTAL	138,200

Notes: (S) Scope Change; (E) Estimate revised

Schedule

The modifications to the scope of work described in this section have affected the schedule of the Sewage Sludge Management Program. A revised schedule is shown in Figure 1. Studies and monitoring work associated with the solids storage basins (4.1-4.8) will be completed at the end of 1977. It is expected that the final EIR (7.1) will be adopted by July 1, 1978. Sludge spreading work (5.2) will be completed by fall of 1978 and monitoring work (5.3) will extend through the following spring. The report on the dedicated land disposal study (5.1) will be completed by July 1, 1979. The overall report for the Sewage Sludge Management Program (1.3) is scheduled to be completed by October 1979. The only task that will extend into 1980 will be preparation of the dedicated land disposal EIR (7.2) which is slated for adoption by July 1, 1980.

FIGURE I
SEWAGE SLUDGE MANAGEMENT PROGRAM SCHEDULE



TASKS	SUBTASKS
1. PROGRAM MANAGEMENT	1.1 WORKPLAN REVISIONS
	1.2 MANAGEMENT
	1.3 FINAL REPORT PREPARATION
2. REGULATORY AGENCY COORDINATION	2.1 LIASON AND SPECIAL REPORTS
3. SOURCE SURVEY PHASE I	3.1 RAW SLUDGE STUDIES
	3.2 INFLUENT-EFFLUENT STUDIES
	3.3 PROGRESS REPORT PREPARATION
4. SOLIDS STORAGE BASIN STUDIES	4.1 OPERATION & PERFORMANCE EVALUATION
	4.2 EXPERIMENTAL STUDIES
	4.3 GROUNDWATER MONITORING AND SITE ENGINEERING WORK
	4.5 SOURCE ODOR CONTROL STUDY
	4.6 DEVELOPMENT OF LARGE AREA EMISSION ODOR CRITERIA
	4.8 MANAGEMENT AND REPORT PREPARATION
5. DEDICATED LAND DISPOSAL STUDY	5.1 MANAGEMENT AND REPORT PREPARATION
	5.2 SITE DEVELOPMENT & SLUDGE SPREADING
	5.3 SLUDGE AND DISPOSAL SITE MONITORING
6. MISCELLANEOUS USE DETERMINATION	6.1 MICROBIOLOGICAL STUDY
	6.2 VIRUS STUDY
7. ENVIRONMENTAL IMPACT REPORTS	7.1 SOLIDS STORAGE BASIN EIR
	7.2 DEDICATED LAND DISPOSAL EIR

ATTACHMENT A

WORK PLAN

ENVIRONMENTAL IMPACT REPORTS SEWAGE SLUDGE MANAGEMENT PROGRAM

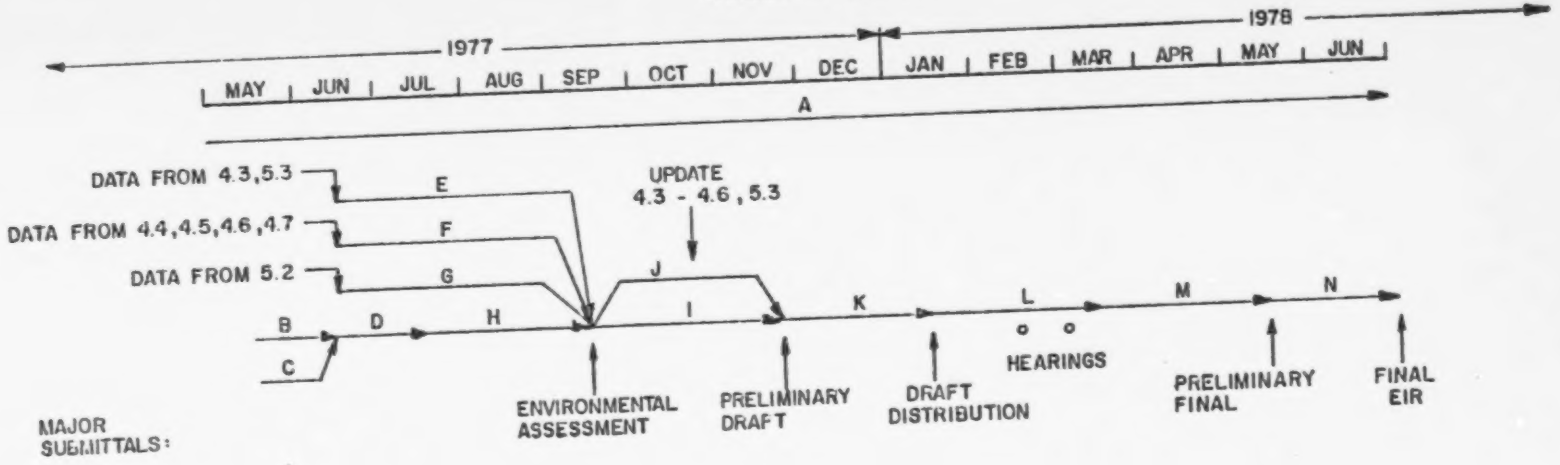
Two environmental impact reports are needed in conjunction with solids system implementation for the Sewage Sludge Management Program. The first EIR is needed early in the program so that an alternate use of solids storage basins (SSBs) is given full consideration. Adequate time must be reserved after the first decision point (July 1, 1978) to design and construct the solids handling system that will be used when the Regional Plant comes on line. Ordinarily all decisions about the program to be implemented would be made in concert with the first EIR (termed the SSB EIR due to its expected emphasis). However, only a portion of the data on soil and water quality effects of dedicated land disposal (DLD) will be available at the time of the first EIR. Therefore, a second EIR (termed the DLD EIR) is needed later in the program to determine the ultimate disposal method for the stabilized solids. The first EIR, however, will evaluate all options through the disposal phase to keep the entire solids program in perspective. Figure 2 shows the schedules of the two EIRs.

The EIRs are designed to meet applicable State law and regulations. Newly adopted EIR guidelines specifically allow material to be incorporated into an EIR through referencing all or specific parts of other reports and studies. This will be extremely helpful because so much information has already been developed in studies, project reports, and other EIRs related to the Sacramento Regional Wastewater Management Program. Brief summaries of incorporated material will be used when appropriate. Any such documents referenced will be made available to the public during the review process.

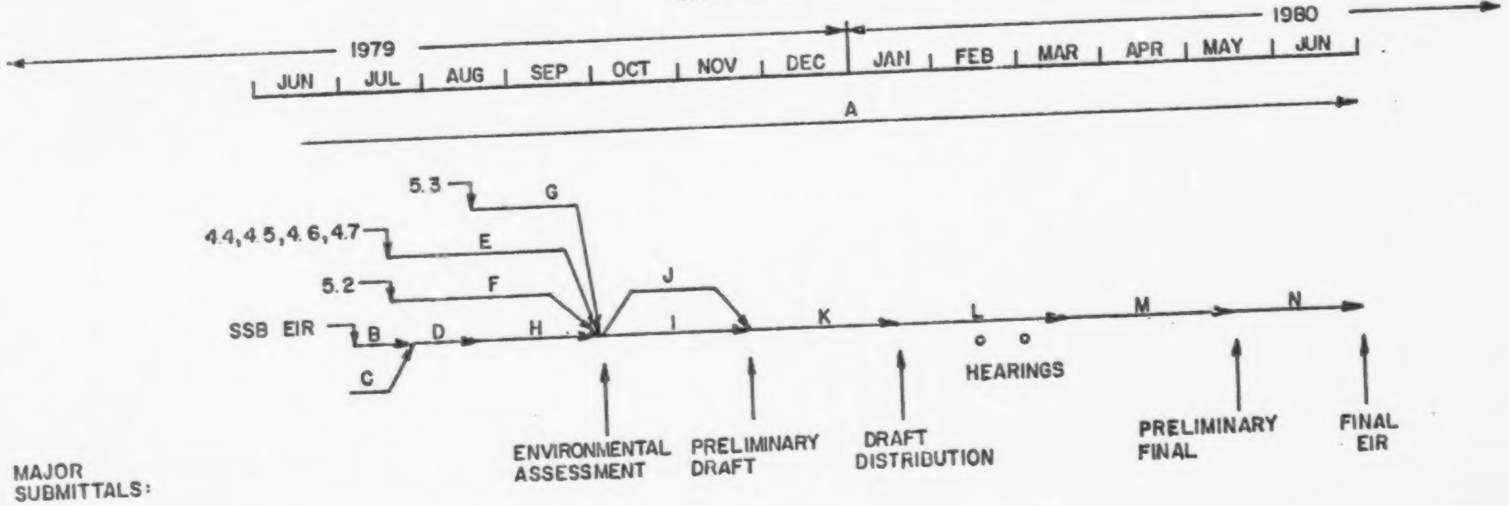
Key subtasks for each EIR are briefly described in this attachment. Total cost for the two EIRs is estimated to be $228,000 including direct costs. The cost for the SSB EIR (Subtask 7.1) is estimated to be $119,000 and the cost for the DLD EIR (Subtask 7.2) is estimated to be $109,000. Manhour requirements and costs are detailed in Section 4 of this proposal.

FIGURE 2
EIR SCHEDULES

SUBTASK 7.1 SSB EIR



SUBTASK 7.2 DLD EIR



SOLIDS STORAGE BASIN
ENVIRONMENTAL IMPACT REPORT
(SUBTASK 7.1)

Subtask 7.1 is the prepration of an Environmental Impact Report on additional solids processing facilities for the Sacramento Regional Wastewater Treatment Plant. The objective of this EIR is to provide appropriate analysis of solids handling options so that decisions on the next step (construction of proposed SSBs) for the solids processing system can be made. Therefore, considerable effort is expected to be necessary to evaluate the effects of SSB systems versus effects of alternate arrangements. A subsequent EIR (Subtask 7.2) is expected to detail the effects of final disposal of wastewater solids. Subtasks are described in the following sections. Manhour requirements and costs are detailed in Section 5 of this proposal.

A. PROJECT MANAGEMENT

Project management involves:

- Overall work assignments
- Management of the EIR preparation including maintenance of status and progress reports
- Coordination of time schedules and work assignments for SSB and related studies
- EIR team management

B. BACKGROUND INFORMATION

Site, nonsite, and regional environmental information will be developed. Data concerning the wastewater program now underway will be reviewed briefly with emphasis on solids production. Legislative, regulatory, jurisdictional, and planning requirements affecting solids handling and disposal will be presented. Political issues and public acceptance factors will be identified. Background data on surface and groundwater, climate, air quality, and land use will be presented. This will constitute the regional environmental and social setting as well as project related setting including solids production quantities and solids characteristics.

C. ENGINEERING SERVICES

Engineering layout and cost information for most of the alternatives are available from the 1975 Solids Study or information developed subsequently. However, alternatives relating to the dewatering of SSB material have not been specifically evaluated. Data needed for each alternative includes:

- Implementation schedule
- Solids flow sheet
- Update on capital and O&M costs
- Energy usage in construction and operation. This should include energy used in equipment and chemicals manufacturing and transportation energy.
- Number of employees
- Operational problems if any
- Amount of land needed and location

Other data are likely to be needed as the environmental evaluation of alternatives proceeds.

D. PRELIMINARY EVALUATION

A preliminary evaluation of solids handling systems will be necessary in order to explain the historical situation and construction underway at the Sacramento Regional Wastewater Treatment Plant. It is assumed that within this evaluation certain alternatives can be eliminated, i.e., incineration and lime stabilization. Alternative systems remaining will be discussed in detail. Table 1 lists the options that are considered viable. Other options that will be discussed but do not appear to be viable at this time include:

- Gamma radiation or pasteurization and subsequent utilization
- Composting and land utilization/reclamation
- Product marketing

E. ODOR EVALUATION

Odors are potentially one of the most significant effects of SSB operation. Input from Subtasks 4.4, 4.5, and 4.6 will be provided for this effort. Mitigation measures for this impact are being studied, and the results will be available for inclusion

TABLE 2

POTENTIAL LIST OF MAJOR ALTERNATIVES*

	Initial Processing/ Handling	Subsequent Processing/ Handling	Disposal
I.	SSB	--	Agricultural land utilization
		--	Dedicated land disposal (lagooning)
		--	Dedicated land disposal (liquid spreading)
		Dewatering	Dedicated land disposal (trenching)
II.	Dewatering	--	Sanitary landfill
		--	Dedicated land disposal (trenching)

*Assumes starting point is anaerobically digested sludge.

in the EIR. All alternatives must be evaluated for this parameter including odors from all disposal options. Most of the effort in this subtask will be to incorporate data from studies underway into meaningful information for the EIR reader.

F. WATER QUALITY EVALUATION

Another major issue associated with any open storage of sewage sludge is the effect on surface and groundwaters. The SSB storage alternative is being studied for its water quality effects. Information on soil solution transportation and groundwater movement will be available for use in the EIR. Surface runoff problems have been eliminated by construction of a storage dike above the maximum floodplain and confinement of all rainwater within the basins. These facts will be documented.

Preliminary indications of the level of impact will be determined for all alternatives in order to place the water quality issue in perspective. Water quality monitoring work associated with the SSBs (Subtask 4.3) will be completed by the end of 1977 and be available for the EIR. However, water quality monitoring of the dedicated land disposal program (Subtask 5.3) will not be completed until June of 1977. Thus, only SSB-related information will be available for use in the first EIR. An extensive analysis of the water quality effects of dedicated land disposal will be performed in the second EIR.

G. SOILS EVALUATION

One of the issues to be evaluated in the EIR is the effect of long-term application of wastewater solids on the soil. This is particularly important in respect to the later use of this land for agricultural purposes. What information that is available from Chicago, San Jose, and other studies will be summarized. Extensive analysis is not anticipated at this time since it is expected that the land used for the SSBs will never be released back into agricultural production. Extensive analysis of disposal to agricultural land will not be carried out at this time since spreading solids on agricultural land is an option that will be covered in detail in the second EIR in 1979.

H. ENVIRONMENTAL ASSESSMENT

This subtask involves the assessment of impacts other than the specific ones evaluated in subtasks E, F, and G. Effects which need to be quantified if possible include:

- Economic evaluation of alternatives including financial impact to homeowners and others.
- Land utilization--loss of land from agricultural production, need for buffer zone, land use around the processing/disposal area, effect on future development.
- Energy needs.
- Transportation effects for sanitary landfill disposal.
- Resource conservation.
- Institutional constraints.
- Public acceptability.

This task concludes with production of the environmental assessment.

I. RECOMMENDED PROGRAM

Review of the assessment will be conducted and the recommended program developed. Effects of the recommended program will be summarized along with the options available for ultimate disposal. Updated information from other subtasks will be available at this point to check assumptions used and resulting evaluations.

J. PRELIMINARY DRAFT PRODUCTION

A Preliminary Draft EIR will be produced and submitted for District review. This task includes mainly typing, drafting, editing, and production costs; however, there is expected to be some updating of information from data collected in the summer and fall of 1977 concerning odors and water quality.

K. PRODUCTION OF DRAFT EIR

Review by the District and State Water Resources Control Board and Regional Water Quality Control Board staff is expected to result in some changes. The review would take about three weeks with two more weeks to make any changes and three weeks to print and distribute the draft. About 300 copies would be needed.

L. DRAFT EIR REVIEW

A 60-day review period is assumed to be provided within which time two hearings are expected by the District Board as well as meetings with regulatory agencies.

M. PRELIMINARY FINAL EIR

Responses to comments will be generated in a supplemental report to be printed for District review. If project changes or responses are significant, this task may take about two months. If few responses or changes are needed, the time could be shortened.

N. FINAL EIR

The Preliminary Final EIR will be reviewed by District staff, changes made, and the Final EIR printed as a supplemental report. This task is estimated to take about six weeks.

DEDICATED LAND DISPOSAL
ENVIRONMENTAL IMPACT REPORT
(SUBTASK 7.2)

Subtask 7.2 is the preparation of an Environmental Impact Report on solids disposal systems. The objective of this EIR is to bring to bear information necessary to make the best judgment possible concerning solids disposal. The systems expected to be evaluated are listed within the discussion on Subtask 7.1 (Table 1). Dedicated land disposal techniques currently appear to be the most desirable method of solids handling. Subtasks are described in the following sections. Manhour requirements and costs are detailed in Section 5 of this proposal.

It may be desirable to incorporate the SSB EIR or parts of it directly into the DLD EIR. This could be accomplished by referencing the SSB EIR and summarizing the data contained within it.

A. PROJECT MANAGEMENT

Project management involves:

- Overall work assignments
- Management of EIR preparation including maintenance of status and progress reports
- EIR team management

B. BACKGROUND INFORMATION

The SSB EIR can be used for much of the background. However, certain aspects may need to be updated. Since regulatory requirements for solids handling are in the formative stage at this time, it is expected that this information will need considerable reexamination.

C. ENGINEERING SERVICES

Updated cost data will be needed as well as any changes in expected implementation of the alternatives. For example, loading rates will be defined during the 1978 spreading operation and can be used to refine earlier cost estimates for dedicated land disposal. However, data supplied for the SSB EIR will constitute the basis for providing these services.

D. PRELIMINARY EVALUATION

The entire array of disposal alternatives will be examined and narrowed to the feasible options. Alternatives such as applying liquid stabilized sludge for agricultural land utilization and other marketing possibilities for end products will be explored in order to evaluate the feasibility of these methods.

E. WATER QUALITY EVALUATION

The effect on surface and groundwater from dedicated land disposal is probably the major issue to be addressed in the DLD EIR. Output from Subtask 5.3 will be the primary information available. Data from other studies will be referenced.

F. SOILS EVALUATION

The soils evaluation will be more extensive in the DLD EIR than in the SSB EIR to evaluate the potential beneficial and adverse effects on future land productivity. Data will be available from Subtask 5.3 concerning soils effects from dedicated land disposal. (It is expected to complete the dedicated land disposal report by July 1, 1979, so all monitoring data will be available for use in the EIR.) Effects on soils from alternative disposal systems will be compared with DLD.

G. ODOR EVALUATION

Odor data from DLD and other systems will be summarized, evaluated, and compared.

H. ENVIRONMENTAL ASSESSMENT

Assessment of effects other than those evaluated in Subtasks E, F, and G will be made. The following issues need to be addressed.

- Economic evaluation of alternatives
- Land utilization
- Energy needs
- Transportation effects
- Resource conservation
- Institutional/political constraints
- Public acceptability
- Public health

I. RECOMMENDED PROGRAM

A review of the alternative assessment and other project information will result in a recommended program. Effects of the recommended program will be described.

J. PRELIMINARY DRAFT PRODUCTION

A Preliminary Draft EIR will be produced and submitted for District and State review. This task includes mainly typing, drafting, editing, and production costs.

K. PRODUCTION OF DRAFT EIR

Review by the District and State Water Resources Control Board and Regional Water Quality Control Board staff is expected to result in some changes. The review would take about three weeks with two more weeks to make any changes and three weeks to print and distribute the draft. About 300 copies would be needed.

L. DRAFT EIR REVIEW

A 60-day review period is assumed to be provided within which time two hearings are expected by the District Board as well as meeting with regulatory agencies.

M. PRELIMINARY FINAL EIR

Responses to comments will be generated in a supplemental report to be printed for District review. If project changes or responses are significant, this task may take about two months. If few responses or changes are needed, the time could be shortened.

N. FINAL EIR

The Preliminary Final EIR will be reviewed by District staff, changes made, and the Final EIR printed as a supplemental report. This task is estimated to take about six weeks.

ATTACHMENT B

REVISIONS TO THE FEBRUARY 17, 1976 WORK PLAN

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

J231A
1.1

December 17, 1976

Mr. William N. Anderson
Sacramento Regional Wastewater
Management Program
1101 R Street
Sacramento, California 95814

SEWAGE SLUDGE MANAGEMENT PROGRAM - REVISION OF SSMP WORK PLAN AND PROPOSAL

Contained herein are revisions to the February 17, 1976 SSMP Work Plan and Proposal. These revisions are in response to the March 3, 1976 District letter to SAC. Comments contained in the letter were the result of District staff consideration and adoption of the Work Plan on February 19, 1976.

Changes in the Work Plan include: (1) considerable alteration of the SSB experimental studies (subtask 4.2) to include a deliberate upset of the test basins; (2) more clearly stating the objectives of tasks 3 and 4; (3) expanding the description of the dedicated land disposal sites (DLDS) to include a reference to site selection criteria, land use planning and flood protection (task 5); (4) providing, in task 1, a detailed sampling and analysis program for the SSMP; (5) incorporating responsibility matrices into all tasks; (6) providing the District with quarterly resumes of SSB monitoring data; (7) updating the costs of those portions of the Work Plan that are included here; and (8) revising, in task 5, the discussion of current State and Federal regulations relating to land disposal of sewage sludge.

Response to District comments of March 3 not addressed to here will be forthcoming shortly. We will be glad to answer any questions you might have on this material.

SACRAMENTO AREA CONSULTANTS

Warren R. Uhte
Project Manager

br
enclosure
cc: Lyle Hoag
Al Wolfenden
Paul Scheidegger

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ATTACHMENT A

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 1 - PROGRAM MANAGEMENT

Program management involves the following three subtasks: (1) authorization preparation and all preparatory work done on other sub-authorizations prior to formal acceptance of sewage sludge management program; (2) management of the entire three-year sludge studies including the maintenance of monthly status reports, quarterly progress reports and annual interim reports; and (3) preparation of final recommendation and documentation report. Work shall be as described in the following detail descriptions of work.

Final recommendations and documentation report will set forth the Sacramento Regional Wastewater Management Program (SRWMP) sewage sludge management program for the next twenty years.

Task Organization and Work Assignments

Task 1 will be managed by SAC acting under the direct supervision of the District. All funding agency contacts will be made by the District. Table 1.0-1 presents the organization chart of these relationships. Table 1.0-2 identifies major work assignments and lists who is responsible for their completion.

Detailed Test Plan

Table 1.0-3 is a detailed test plan for the various subtasks within the Revised Work Plan. Under each subtask are listed the sample types, information on the sampling program, analytical parameters sought and the source of the analytical methods used. More discussion of the sampling program is included in the following subtask descriptions. It should be noted that often there exists several methods of analysis for the different chemical parameters. The actual method of analysis chosen depends on such things as sample size submitted, presence or absence of suspended matter and organics, the purpose of the test, and, the analyst's judgment as to how each method can best serve all these parameters.

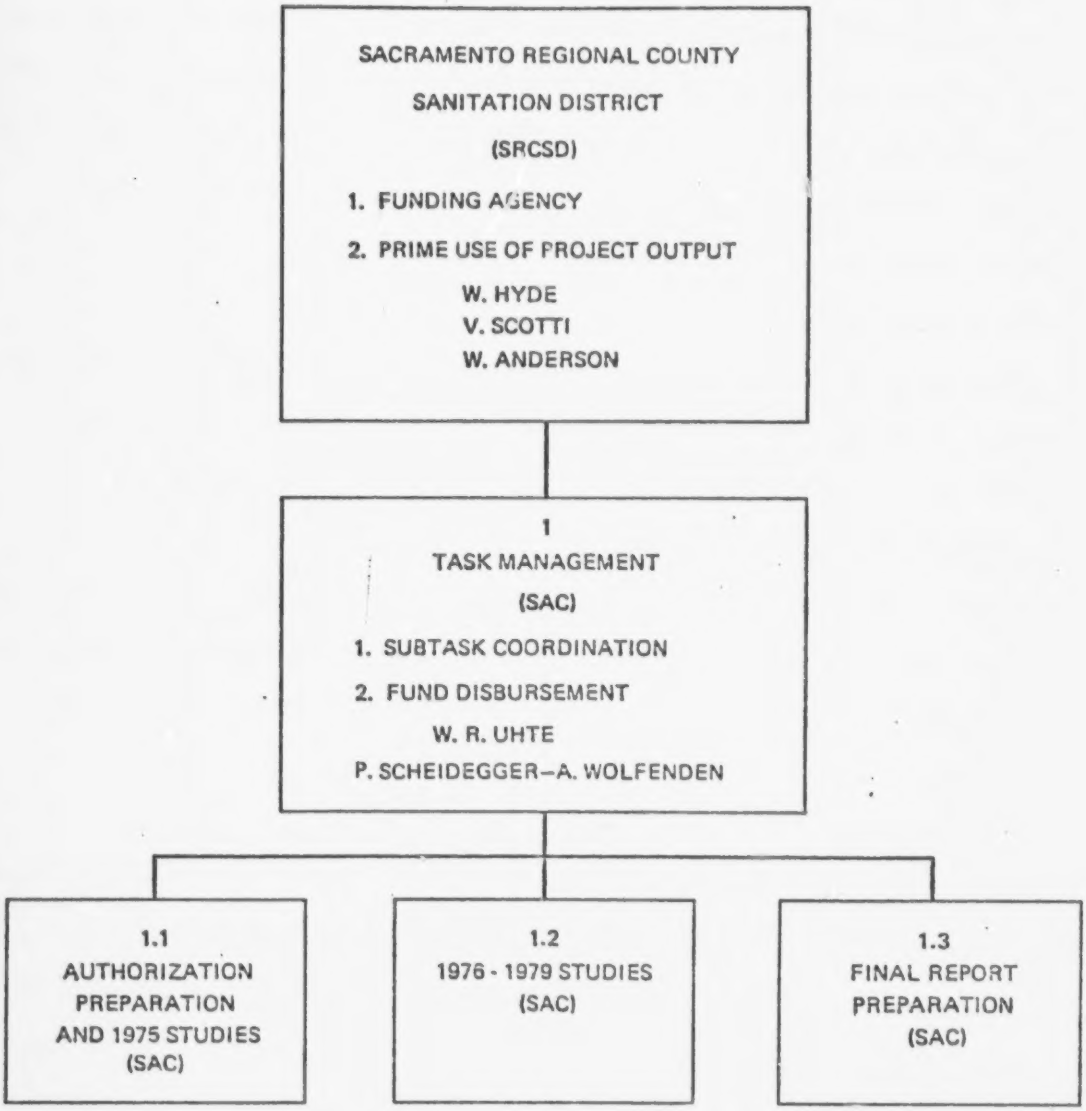


Table 1.0-1. Program Management Task Organizational Chart

Table 1.0-2 Program Management - Major Work Assignments

Work No.	Description of Work	Assignment
1	Coordination of development outside consultants proposals	SAC
2	Preparation of job authorizations and related material	SAC
3	Management for outside consultant services	SAC
4	Assure proper coordination and expedition of the work involved	SAC
5	Assure adequate documentation of data collected	SAC
6	Preparation and enforcement of program milestones	SAC
7	Scheduling the preparation of monthly status statements	SAC
8	Formulation of quarterly progress reports	SAC
9	Compilation of interim annual reports	SAC
10	Final report preparation, publication and development of complete disposal recommendations	SAC

Table 1.0-3. SSMP Program Management Detailed Test Plan

Subtask	Sample medium	Sampling/analytical responsibility	Total samples/sampling program 1976	1977	1978	1979	Analytical parameters, units[a]	Analytical method source
3.1	Raw sludge	SAC/EQA[b]	Task not started	50/5 weeks daily comp. & 3 weekly grab	-[c]	-	(Cd, Zn, Cu, Ni, Be, Mo, Se, chl. hydrocarbons, & PCBs) ppm dry wt.	SM[d]
3.2	Influent-effluent	SAC/EQA	Task not started	20/5 weeks daily composite	-	-	Cd, Zn, Cu, Ni, Be, Mo, Se, chl. hydrocarbons, & PCBs	SM
4.1	Digested sludge	PS[e]/PS	Daily grab of each digester	Daily grab of each digester	-	-	Quantity (gpd), total and volatile solids % (TS & VS)	SM
	Digested sludge	SAC/EQA	3/quarterly composites	4/f	-	-	Alkalinity, Cl, NH_3-N, soluble P, SO_4, (TP & TN) % dry wt, (TS & VS)%, pH, EC (μmhos/cm)	SM
	SSB surface layer	PS/PS	3 weekly grab samples in each basin	3 weekly grab samples in each basin	-	-	pH, temp (C), H_2S, D.O.	SM
	SSB surface layer	PS/EQA	224/monthly-weekly grab in 8 basins	224/f	-	-	EC (umhos/cm), turbidity (NTU), algae count (organisms /ml)	SM
	SSB solids monitoring	SAC/EQA	364/quarterly sampling at 2-foot increments at N-S end in each basin-26 total basin invent.	400/32 samples total basin inventories	-	-	(TS & VS)%, EC (μmhos/cm), specific gravities	SM
	SSB sludge analysis	SAC/EQA	26/quarterly composites of solids monitoring samples for each basin	32/f	-	-	Alkalinity, Cl, NH_3-N, soluble P, SO_4, (TP, TN) % dry wt, (Ca, Mg, K, Na, Zn, Cu, Cr, Pb, Ni, Ag, Cd, Hg, As, Se, Be, Mo) ppm dry wt, Zn/Cd ratio, (TS & VS)%, EC (μmhos/cm), pH (PCBs 1242 & 1254, technical chlordane & other pesticides) ppm dry wt	SM
4.2	SSB surface layer	SAC/SAC	Task not started	11 weeks total sampling frequency undetermined (prob. every 2 hours)	-	-	D.O., turbidity (NTU), temp (C), pH, EC (μmhos/cm) algae count (organisms/ml)	SM
4.3	Groundwater	PS/EQA	72/monthly grab of each test well for 10 months	80/f	-	-	Alkalinity, Cl, PO_4, hardness, pH, TKN, NH_3-N, organic-N, NO_3-N, NO_2-N, COD, pH, EC (μmhos/cm)	SM

Table 1.0-3. SSMP Program Management Detailed Test Plan (Cont'd)

Subtask	Sample medium	Sampling/analytical responsibility	Total samples/sampling program				Analytical parameters, units[a]	Analytical method source
			1976	1977	1978	1979		
	Groundwater	PS/EQA	11/semi-annual grab of each test well	16/f	-	-	Alkalinity, Cl, SO_4, HCO_3, Na, K, Ca, Mg, CO_2, hardness, TDS, EC (μmhos/cm), SiO_2, F, Fe, Mn, turbidity (NTU), pH, TKN, CO_3 NH_3-N, organic-N, NO_3-N, NO_2-N, COD	SM
	SSB leachate	DCB[g]/DCB	4/obtained from east pilot SSB	4/ to be obtained from SSB 5 & 6-work to be done under subtask 5.3	-	-	EC (μmhos/cm), NO_3-N, PO_4-P, SO_4, HCO_3+CO_3, Cl, Ca, Mg, Na, K, pH, B	SM
4.5	Surface layer-pilot SSBs	PS/EQA	12/weekly grab in 2 pilot SSBs, 11/15-12/31/76	38/weekly grab, 1/1-5/15/77	-	-	EC (μmhos/cm), turbidity (NTU), algae count (organisms/ml)	SM
5.3	Harvested sludge	DCB/EQA	6/composite	12/f	12/f	-	Alkalinity, Cl, NH_3-N, soluble P, SO_4, (TP&TN)% dry wt, (B, Ca, Mg, K, Na, Zn, Cu, Cr, As, Pb, Ni, Ag, Cd, Hg, Be, Mo, Se, PCB 1242 & 1254, technical chlordane, other pesticides) ppm dry wt, Zn/Cd ratio, TS(%), pH, EC (μmhos/cm)	SM
	Soil	DCB/(DCB& EQA)	60/12 locations-4 depths, 48 samples before and 12 after yearly sludge application	60/f	60/f	48/12 locations-4 depths	Saturation extracts: pH, EC (μmhos/cm), NO_3-N, PO_4-P, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH, B DTPA extracts[h]: (Cu, Zn, Cd, Ni) mg/kg Special analysis[h]: CEC (meq/100 gms), TKN, NH_4, TOC Pesticide residues[h]: (chl. hydrocarbons & PCBs) μg/kg	UCD-DSPN[i] SM UCD-DSPN EPA[j]
	Soil solution	DCB (DCB & EQA)	64/16 locations-2 depths 2 times per year	128/16 locations-2 depths 4 times per year	128/f	64/same as 1976	EC (μmhos/cm), NO_3-N, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH, PO_4-P, B (chl. hydrocarbons & PCBs) μg/l (see k) Zn, Cd, (see k)	UCD-DSPN EPA SM
	Groundwater	DCB (DCB & EQA)	12/12 locations at once/year	24/12 locations at 2 times/year	24/f	12/same as 1976	EC (μmhos/cm) NO_3-N, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH, PO_4-P, B Zn, Cd (chl. hydrocarbons & PCBs) ug/l (see l)	UCD-DSPN SM EPA
	Surface runoff	DCB/(DCB & EQA)	6/during rainy season	12/f	12/f	12/f	EC (μmhos/cm), pH, turbidity (NTU), TKN, NO_3-N, NH_3-N, TP, Cl, NH_4 (Chl. hydrocarbons & PCBs) μg/l Zn, Cu, Cd, Ni, Pb, Hg	UCD-DSPN EPA SM

Table 1.0-3. SSMP Program Management Detailed Test Plan (Cont'd)

Subtask	Sample medium	Sampling/analytical responsibility	Total samples/sampling program				Analytical parameters, units[a]	Analytical method source
			1976	1977	1978	1979		
	Morrison Creek water	SAC/EQA	60/5 locations-12 times/year grab	60/ℓ	60/ℓ	25/5 locations 5 times/year grab	Zn, Cu, Cd, Ni, Pb, Hg, TKN, NO_3-N, TPO_4, pH, EC(µmhos/cm), turbidity (NTU), (T. coli., F. coli, & F. strep) MPN/100 ml, NH_3-N	SM
							(chl. hydrocarbons & PCBs) ug/l	EPA
6.1	SSB sludge	SAC/DS[m]	22/quarterly composite of 3 depths in north portion of each basin	32/ℓ	-	-	Total aerobic bacteria, Salmonella, Shigella, F. strep.	QL[n]
							Helminths, protozoans	JHT[o]
	Raw sludge	DS/DS	4/quarterly grab	4/ℓ	-	-	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
	Digested sludge	DS/DS	6/quarterly composite of 3 depths in digester, alternate digesters	12/ℓ	-	-	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
	Harvested sludge	DS/DS	2 /composite	4/ℓ	4/ℓ	-	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
	Sludge treated soils	DS/DS	16/4 locations at 4 times/year	4/4 locations at 1 time/year	4/ℓ	4/ℓ	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
	Soil control	DS/DS	4 /location at 4 times/year	-	-	-	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
	Surface runoff	DS/DS	None/during rainy season	4/ℓ	4/ℓ	4/ℓ	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
	Morrison Creek water	DS/DS	8 /2 locations once per quarter [illegible]	8/ℓ	8/ℓ	4/ℓ	Total aerobic bacteria, Salmonella, Shigella, F. strep	QL
							Helminths, protozoans	JHT
6.2	SSB sludge	SAC/DS	22 /quarterly composite of 3 depths on north portion of each basin	32/ℓ	-	-	Hepatitis Type B Antigen	RQ[p]
	Raw sludge	DS/DS	4 /quarterly-grab	4/ℓ	-	-	Hepatitis Type B Antigen	RQ

Table 1.0-3. SSMP Program Management-Detailed Test Plan (Cont'd)

Subtask	Sample medium	Sampling/analytical responsibility	Total samples/sampling program				Analytical parameters, units[a]	Analytical method source
			1976	1977	1978	1979		
6.2	Digested sludge	DS/DS	6 /quarterly composite - 3 depths in digester-alternate digesters	12/f 12÷4=3 [illegible]	-	-	Hepatitis Type B Antigen	RQ
	Harvested sludge	DS/DS	2 /composite	4/f	4/f	-	Hepatitis Type B Antigen	RQ
	Surface runoff	DS/DS	None/during rainy season	4/f	4/f	4/f	Hepatitis Type B Antigen	RQ
	Morrison Creek water	DS/DS	8/2 locations-once per quarter	8/f	8/f	4/f	Hepatitis Type B Antigen	RQ

[a] Except for subtasks 6.1 and 6.2, units are in mg/l unless otherwise noted.

[b] EQA = Environmental Quality Analysts, Inc.

[c] -Indicates that sampling of this medium in this subtask of the SSMP has been completed.

[d] SM = Standard and Methods for the Examination of Water and Wastes, APHA, AWWA, WPCF, 14th ed., 1975.

[e] PS = plant staff.

[f] Indicates that the sampling program is the same as it was in the preceding year.

[g] DCB = Dwight C. Baier.

[h] 20% of total annual samples to receive these analyses.

[i] UCD-DSPN = University of California at Davis - Department of Soils and Plant Nutrition.

[j] EPA = Methods of Chemical Analysis of Water and Wastes, U. S. Environmental Protection Agency, 1974.

[k] 10% of total annual samples to receive these analyses.

[l] 25% of total annual samples to receive this analysis.

[m] DS = Dr. David Storm of Spray Waste Inc.

[n] QL = Quigor Laboratories

[o] JHT = Dr. J. H. Theis, University of California at Davis, Department of Medical Microbiology.

[p] RQ = Dr. Robert Quinn of the University of California at Davis, Department of Biochemistry.

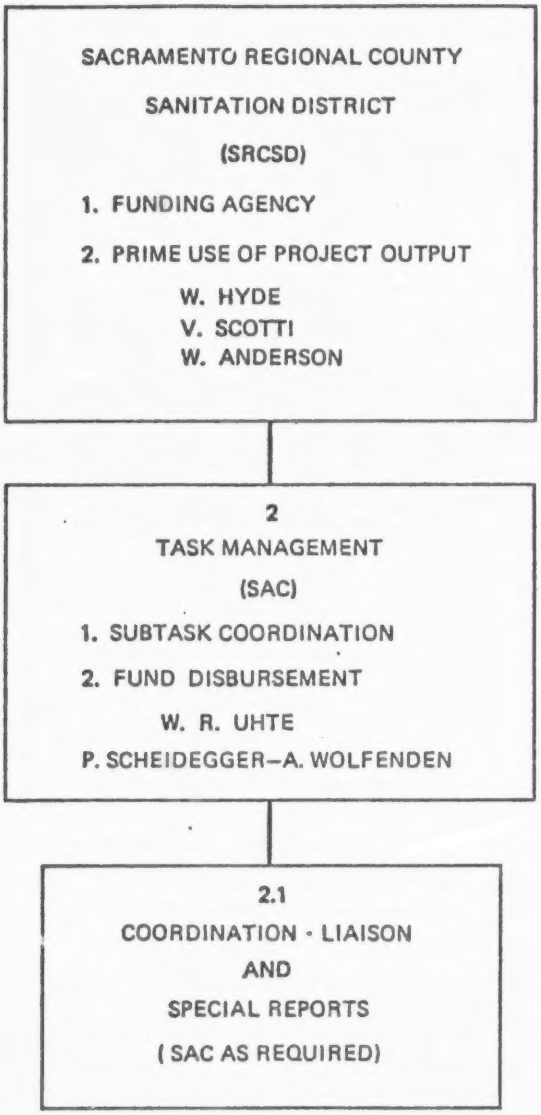
SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 2 - REGULATORY AGENCY COORDINATION

Regulatory agency coordination involves keeping current with federal, state, regional, and county agency proposed and adopted regulations and assuring that such agencies are kept fully informed of the purposes and findings of the sludge management program. Work shall be as described in the following detailed descriptions of work.

Task Organization and Work Assignments

Task 2 will be managed by SAC under the direct supervision of the District. All funding agency contacts will be made by the District. Table 2.0-1 presents an organization chart of these relationships. Table 2.0-2 identifies major work assignments and lists responsibility for completion to one of the subtasks.



SACRAMENTO REGIONAL COUNTY
SANITATION DISTRICT
(SRCSD)

1. FUNDING AGENCY
2. PRIME USE OF PROJECT OUTPUT

W. HYDE
V. SCOTTI
W. ANDERSON

2
TASK MANAGEMENT
(SAC)

1. SUBTASK COORDINATION
2. FUND DISBURSEMENT

W. R. UHTE
P. SCHEIDEGGER–A. WOLFENDEN

2.1
COORDINATION - LIAISON
AND
SPECIAL REPORTS
(SAC AS REQUIRED)

Table 2.0-1. Regulatory Agency Coordination Task Organizational Chart

Table 2.0-2 Regulatory Agency Coordination - Major Work Assignments

Work No.	Description of Work	Assignment
1	Attend regulatory agency briefings on new regulations	SAC
2	Assure that regulatory agencies are kept fully informed of the purposes and findings of the sludge management program	SAC
3	Preparation of responses to proposed regulations	SAC
4	Attend regulatory sponsored sewage sludge disposal seminars	SAC
5	Preparation of special material to support District applications for agency permits or approvals	SAC

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 3 - SOURCE SURVEY - PHASE I

Heavy metals and persistent organics are recognized by regulatory agencies as two of the major deterrents to the successful disposal of sewage sludge. They are also probably the most easily traced and therefore subject to practical source detection and elimination. The 1975 Solids Study realized the necessity to determine, as quickly as possible, if some relatively economical means of source control could affect the present levels of heavy metals and persistent organics in the existing systems.

The most logical, efficient and rapid means of detection of unusually high levels of these toxic materials in various areas of the system is to examine the raw primary and secondary sludge of the existing treatment plants. It is believed the concentration of solids in the raw sludge acts as a multiplier which helps to magnify differences which might otherwise go undetected and as a retainer which assures that single daily grab samples reflect, as much as possible, most of the material entering the system each day.

However, while raw sludge sampling provides an excellent means of monitoring for excessive heavy metals or persistent organics in system solids, it does not provide the interrelationships between what is collected and what is actually entering the treatment plant. To determine this information requires the examination of the contents of plant influent and effluent heavy metal and persistent organic levels in relationship to the level of similar materials in the raw sludge. This interrelationship information will also provide a check on the validity of the assumption that daily grab samples of raw sludge are representative of the entire day's solids inflow.

During the past several years, the City and County have collected extensive data on the level of many heavy metals and persistent organics within their respective collection systems. As part of the preparation of the progress report on Phase I of the source survey, it is expected that this material will be reviewed and compiled into meaningful tables for inclusion in the report. It is also expected that the report will include information from the recently completed District-wide customer survey, indicating any potential sources where heavy metals or persistent organics might enter the sewerage system.

Source survey - Phase I involves the following three subtasks: (1) Raw sludge studies - collection and analysis for heavy metals and chlorinated hydrocarbons of five weekly composite samples of raw sludge from 10 existing wastewater treatment plants; (2) Influent-effluent studies - collection and analysis for heavy metals and chlorinated hydrocarbons of five weekly composite samples of influent and effluent from City Main and Central wastewater treatment plants; (3) Step 1 report preparation - preparation of a progress report providing recommendations regarding need for further source control survey work. Work shall be as described in the following detail descriptions of work.

Task Objectives

The data gathering and information extraction process will be designed and directed to achieve the following objectives:

1. To collect and analyze raw sludge samples from 10 District-supervised wastewater treatment plants so that it may be determined if any of the plants have higher than normal levels of heavy metals or persistent organics.
2. To collect and analyze influent and effluent samples from the City Main and Central wastewater treatment plants in order to establish whether influent and effluent levels of metals and organics can be related to the raw sludge levels determined in Task Objective 1, and the plant removal efficiency.

3. After review of data developed under Task Objectives 1 and 2, indicate which treatment plants are receiving abnormally high levels of either heavy metals or persistent organics.

4. To pinpoint actual excessive sources of these materials by:

    a. Comparing the determined levels with normal levels as developed by literature research.

    b. Further analysis, if considered necessary, of selected freeze-dried samples in order to determine toxic material high level frequency and concentration.

Task Organization

Table 3.0-1 is an organizational chart identifying the relationship between management of the task subdivisions and the funding agencies. The subtasks are named together with the identity of their leaders or coordinators.

Work Assignments

Table 3.0-2 identifies major work assignments and lists responsibility for completion of one of the subtasks. Table 3.0-3 lists the media which will be sampled; assigns subtask responsibility for sample collection, preparation and splitting; identifies the analytical parameters sought in each media sample; and assigns subproject responsibility for obtaining the laboratory analytical data.

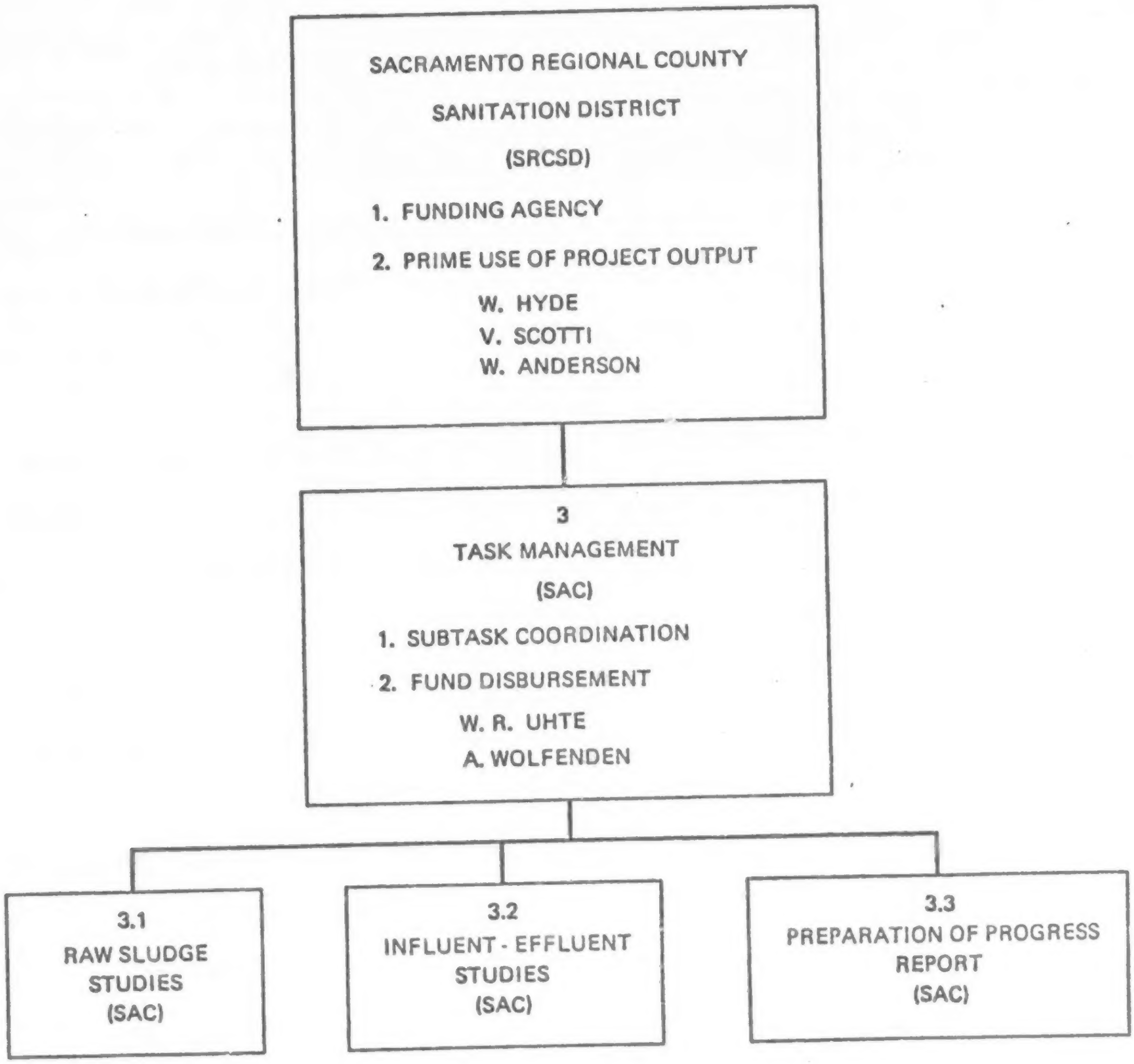


Table 3.0-1. Source Survey - Phase I Task Organizational Chart

Table 3.0-2 Source Survey - Phase I - Major Work Assignments

Work No.	Description of Work	Assignment
1	Raw sludge and influent-effluent sample program preparation	SAC
2	Sample collection - weekly roundup of city and county raw sludge and influent-effluent collected samples	SAC
3	Raw sludge and influent-effluent sample preparation and storage, freeze-drying for long-term storage	SAC
4	Raw sludge and influent-effluent analysis	(See Table 3.0-3)
5	Literature review, previous data review, report preparation and production	SAC
6	Task management and coordination	SAC

Table 3.0-3 Source Survey - Phase I - Sampling and Laboratory Analytical Parameter Responsibility

Sample type	Sampling, sample preparation, sample splitting (when required)	SAC subtask
Raw sludge	SAC	Cd, Zn, Cu, Ni, Be, Mo, Se, chlorinated hydrocarbons, PCB's
Influent-effluent	SAC	(Same as for raw sludge)

DETAIL DESCRIPTION OF WORK - SUBTASK 3.1 - SOURCE SURVEY - PHASE 1 - RAW SLUDGE STUDIES

The work under this subtask involves the collection and storage by District personnel of five weeks of daily and thrice weekly grab samples of raw sludge from 10 District-supervised wastewater treatment plants (Natomas, Highland, Rio Linda, San. 6, Arden, Northeast, Rancho Cordova, Meadowview, City Main and Central). Costs have been allocated to rent the necessary equipment for storage of samples obtained under subtasks 3.1 and 3.2. Samples are to be cooled and stored at a central site. Each week's composite samples will be collected and prepared for each treatment plant by SAC personnel from a portion of each sample. The remaining portions of each sample will be freeze-dried by Environmental Quality Analysts (EQA) for long-term storage.

Weekly composites will be analyzed for heavy metals (cadmium, zinc, copper, nickel, beryllium, molybdenum, and selenium) by atomic adsorption spectrophotography and arc-spark emission spectroscopy and for chlorinated hydrocarbons, PCB's and related compounds by gas chromatography.

Subtask Time and Budget Estimate

Cost for this subtask will be as follows:

Sampling	
Sample program preparation, sample collection and preparation	$ 3,400.00
Cold storage of samples[a]	1,100.00
Freeze-drying of samples[a]	1,600.00
Travel expenses[a]	300.00
Analyses[a]	
Heavy metals (50 samples @ 77.00)	4,100.00
Persistent organics (50 samples @ 70.00)	3,700.00
Total for subtask 3.1	$14,200.00

[a] Includes 7% allowance for SAC.

DETAIL DESCRIPTION OF WORK - SUBTASK 3.2 - SOURCE SURVEY - PHASE 1 - INFLUENT-EFFLUENT STUDIES

The work under this subtask therefore will be coordinated with subtask 3.1 and will involve the collection and storage of five weeks of daily composite samples of influent and effluent from the City Main and Central wastewater treatment plants. Individual samples will be cooled and stored at a central site. Each week's composite samples will be prepared for each treatment plant from a portion of each sample. The remaining portions of each sample will be freeze-dried for long-term storage.

Weekly composites will be analyzed for heavy metals (cadmium, zinc, copper, nickel, beryllium, molybdenum and selenium) by atomic absorption spectrophotography and arc-spark emission spectroscopy and for pesticide residues, PCBs and related compounds by gas chromatography.

Subtask Time and Budget Estimate

Costs for this subtask will be as follows:

Sampling	
Sample program preparation, sample collection and preparation	$1,400.00
Freeze-drying of samples[a]	900.00
Analyses[a]	
Heavy metals (20 samples @ 77.00)	1,600.00
Persistent organics (20 samples @ 70.00)	1,500.00
Total for subtask 3.2	$5,400.00

[a] Includes 7% allowance for SAC.

DETAIL DESCRIPTION OF WORK - SUBTASK 3.3 - SOURCE SURVEY - PHASE 1

PROGRESS REPORT PREPARATION

The report will review and summarize the data developed under subtasks 3.1 and 3.2 and indicate which treatment plants (if any) are receiving abnormally high levels of either heavy metals or persistent organics. After comparing the determined levels with normal levels as developed by literature research, the report will recommend which freeze-dried daily samples (if any) should be further analyzed to determine toxic material high level frequency and concentration as a means of pinpointing actual excessive sources of these materials.

Subtask Time and Budget Estimate

Cost of progress report preparation, including literature review, collection of all data from previous system investigations and the compiling and review of new data developed by subtasks 3.1 and 3.2 and formulation of recommendations will be as follows:

Literature review, previous data review and report preparation	$7,200.00
Report reproduction	1,100.00
Total cost for subtask 3.3	$8,300.00

Most of subtask 3.3 work can be accomplished concurrently with the work of the other two subtasks of this phase of the source control survey, therefore it is expected that this subtask can be complete within six months of authorization to proceed with the work.

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 4 - SOLIDS STORAGE BASIN (SSB) STUDIES

The solids storage basins (SSBs) are considered to be a major component of the 1975 Solids Study recommended regional plant sewage sludge processing and disposal system. These deep basins provide the required buffer between the continuous 24-hour per day, 7-day per week sewage sludge receiving process (anaerobic digestion) and the 80 working day, 4-month per year disposal system (dedicated land disposal). Without this buffer full utilization of natural solar energy (algal production, evaporation and oxidation) in final disposal would be impossible.

Environmentally acceptable basins can be expected to provide the regional plant with disposal flexibility which will allow them to adjust to any climatological condition and assure the complete elimination of solids recycle within the plant's liquid process. The annual cost of the next acceptable sludge disposal system, anaerobic digestion process with dewatering and sanitary landfill disposal, was estimated in the 1975 Solids Study to be $1,000,000 more than the recommended system, anaerobic digestion process with SSBs and sludge reclamation. The proposed change to a dedicated land disposal instead of sludge reclamation will not substantially alter this annual saving. We believe it is imperative that every effort be made to assure that the SSBs can meet every conceivable environmental limitation and that the proposed total $606,000 expenditure to achieve this goal is well justified.

SSB studies involved under this task include the following eight subtasks: (1) Continuing SSB operational and performance evaluations program; (2) SSB experimental work; (3) Continuing SSB groundwater monitoring program and site engineering work; (4) Extended SSB diurnal odor monitoring program; (5) SSB source odor control study; (6) Development of odor control criteria for large emission areas; (7) Feasibility study of covering existing SSBs; and (8) SSB study management, data reduction and report preparation. The final recommendation and documentation report will set forth the final design and operations criteria for incorporation of the SSBs into the Sacramento Regional Wastewater Treatment Plant and provide engineering and environmental data for the SSB EIR.

Task Objectives

The experimentation, data gathering and information extraction process will be designed and directed to achieve the following objectives:

1. To continue the SSB operation and performance evaluation program essential to the success of the proposed staging of the solids managing program and the development of conclusive proof that the SSBs can effectively do their job.
2. To make some evaluations of the long-range value of SSB surface mixers.
3. To examine, in detail, the physical and pathogenic condition of the solids scheduled to be harvested during the summers of 1976 and 1977 so that meaningful data for estimating SSB solids storage capabilities over longer storage cycles can be obtained.
4. To establish optimum operating parameters, once all eight SSBs are operating with surface mixers, in order to allow the basins to function at least one year under routine conditions with subsequent inclusion of this data in the December, 1977 SSB report.
5. To continually monitor the controlled and uncontrolled SSBs for the condition of their supernatent (surface layer) and solids (bottom layer) and the development of mass balances.
6. To obtain the maximum information on the optimum operation of the basins by conducting five experiments, utilizing the smaller pilot SSBs, that will incorporate the most significant and practical work elements in combinations.
7. To continue the test well monitoring program in order to ascertain if any of the SSB contents are entering the groundwater.

8. To determine, using results from diurnal odor studies in 1974 and 1975, which potential odor problems are most hazardous and require future odor studies, such as:
    - a. Determining: 1) an efficient, reliable and cost-effective means of removing excessive odors from the digested sludge being fed to the SSBs; 2) the immediate and long-range effect of this removal on controlled SSBs; and (3) the best means of treating and controlling any odors so removed.
    - b. Establishing what, if any, additive effect large areas with minimum surface odor emissions have on downwind odor concentration.
    - c. Ascertaining the feasibility of covering the SSBs, as an alternative to acceptable odor controlled basins, and determining how they will function.

Task Organization

Table 4.0-1 is an organizational chart identifying the relationship between management and funding agencies and the eight subdivisions of the task. The subtasks are named together with the identity of their leaders or coordinators.

Work Assignments

Table 4.0-2 identifies major work assignments by subtask and lists responsibility for completion of each assignment. Table 4.0-3 lists the media which will be sampled; assigns responsibility for sample collection, preparation and splitting; identifies the analytical parameters sought in each media sample; and assigns responsibility for obtaining the laboratory analytical data.

Work shall be as described in the following detailed descriptions of work.

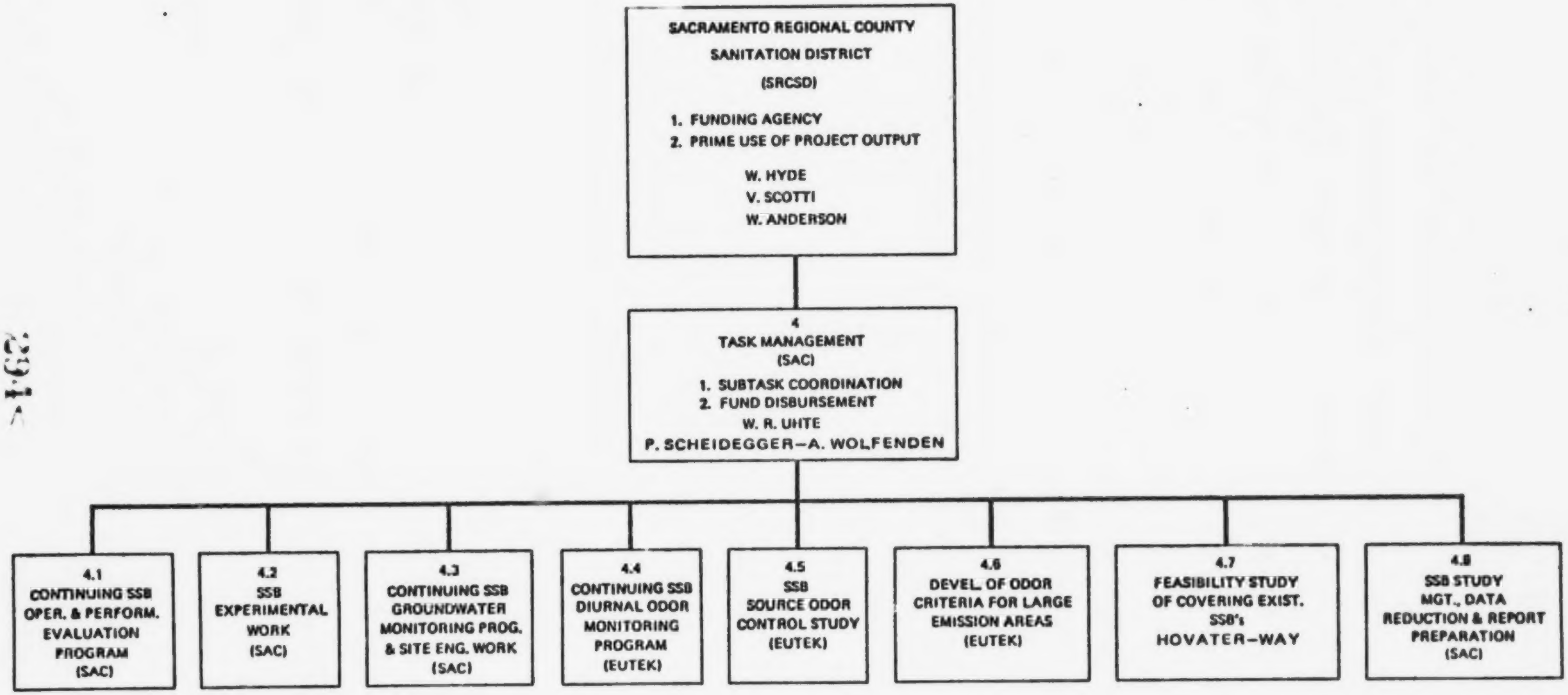


Table 4.0-1. Solids Storage Basin (SSB) Studies Task Organizational Chart

Table 4.0-2 Solids Storage Basin Studies - Major Work Assignments

Subtask	Work No.	Description of Work	Assignment[a]
4-1	1	Continue loading and mixer evaluations . . .	SAC
	2	Establish optimum operating parameters . . .	SAC
	3	Quarterly determination of solids buildup . . .	SAC
	4	Development of mass balances	SAC
	5	Continue monitoring of controlled and uncontrolled basins	(See Table 4.0-3)
	6	Subtask management, data plotting interpretation and evaluation	SAC
4-2	7	Design of experimental work	SAC
	8	Equipment rental (if needed)	SAC
	9	Surface layer sampling	SAC
	10	Surface layer analysis	(See Table 4.0-3)
	11	Subtask management, data evaluation and reports	SAC
4-3	12	Continue monthly groundwater sampling . . .	SAC
	12a	Continue groundwater analysis	(See Table 4.0-3)
	13	Construction and installation of tensiometers	DCB
	14	Installation of soil solution sampling equipment-sample collection	DCB
	15	Charging, calibrating and servicing equipment	DCB
	16	Reading, recording and servicing instruments	DCB
	17	Site foundation engineering for additional SSBs	SAC
	18	Subtask management, data plotting and interpretation, evaluation and reporting . . .	SAC & DCB

Table 4.0-2 Solids Storage Basin Studies - Major Work Assignments (continued)

Subtask	Work No.	Description of Work	Assignment
4-4	19	Maintain and service continuous recording wind velocity and direction and air and water temperature detection equipment	(Plant personnel)
4-5	20	Design and construct necessary facilities to operate two SSBs; one with and one without stripper facilities	Eutek
	21	Develop and evaluate alternate stripping facilities	Eutek
	21a	Provide recommendations for full-scale stripping facility	Eutek
	22	Develop and evaluate alternate odorant control systems	Eutek
	22a	Provide recommendations for full scale odor control facility	Eutek
	23	Monitor operation, including diurnal odor studies of two pilot SSBs	Eutek
	24	Subtask management, data evaluation and reports	SAC & Eutek
4-6	25	Application of a high intensity artificial source odor to the surface area of a single SSB	Eutek
	25a	Creation of the specific climatological conditions required	Eutek
	25b	Monitoring of downward odor concentrations at several locations simultaneously	Eutek
	26	Application of high intensity artificial source odor to the surface area of four SSBs	Eutek
	26a	Creation of the specific climatological conditions required	Eutek
	26b	Monitoring of downwind odor concentrations at several locations simultaneously	Eutek
	27	Wind machine rentals	Eutek
	28	Subtask management, result interpretation, monthly and final report preparation	SAC & Eutek

Table 4.0-2 Solids Storage Basin Studies - Major Work Assignments (continued)

Subtask	Work No.	Description of Work	Assignment
4-8	29	Task management and coordination	SAC
	30	Data plotting and analysis, preparation of quarterly summaries	SAC
	31	Preparation of final report	SAC

[a] Studies for subtasks 4.4 and 4.7 have been completed.

Table 4.0-3. Solids Storage Basin Studies Sampling and Analytical Parameter Responsibility

Subtask	Sample type	Sampling, sample preparation sample splitting (when required)	PS subtask	SAC subtask	DCB subtask
4.1	Digested sludge	PS	Quantity, TS, VS	None	None
	Digested sludge	SAC	None	Alkalinity, Cl, NH_3-N, sol-P, SO_4, TP, TN TS, VS, pH, EC	None
	SSB surface layer	PS	pH, temp., H_2S, DO	None	None
	SSB surface layer	PS	None	EC, turbidity, algae count	None
	SSB solids monitoring	SAC, PS & EQA	None	TS, VS, EC, specific gravities	None
	SSB sludge analysis	SAC, PS & EQA	None	Alkalinity, Cl, NH_3-N, sol-P, SO_4, TP, TN Ca, Mg, K, Na, Zn, Cu, Cr, Pb, Ni, Ag, Cd, Hg, As, Se, Be, Mo, Zn/Cd ratio, TS, VS, EC, pH, PCBs 1242 & 1254, tech chlordane, & other pesticide residues	None
4.2	SSB surface layer	SAC	None	DO, turbidity, temp, pH, EC, algae count	None
4.3	Groundwater	PS	None	Monthly: Alkalinity, Cl, PO_4, hardness, pH, TKN, NH_3-N, organic-N, NO_3-N, NO_2-N, COD, EC	
				Semi annual: The above parameters plus SO_4, Na, K, Ca, Mg, CO_2, TDS, SiO_2, F, Fe, Mn, turbidity	None
	SSB leachate	DCB	None		EC, NO_3-N, PO_4-P, SO_4, HCO_3+ CO_3, Cl, Ca, Mg, Na, K, pH, B
4.5	Surface layer, pilot SSBs	PS	None	EC, turbidity, algae count	

DETAIL DESCRIPTION OF WORK - SUBTASK 4.2 - SSB STUDIES

SOLIDS STORAGE BASIN EXPERIMENTAL WORK

Review of the information gained to date from the operation of the existing solids storage basins (SSBs) has led to the revision of the SSB experimental work as outlined in the February 17, 1976 Revised Work Plan and Proposal. In that work plan, subtask 4.2 called for a series of five experiments utilizing the existing SSBs 1 and 2 with a maximum time requirement of 18 weeks. It is now considered possible to accomplish the necessary experimental work in a maximum of 11 weeks by using the small pilot SSBs. In so doing, SSB 1 and 2 will be retained in their normal operational mode and the two pilot experimental basins currently in operation for the source control study (subtask 4.5) will be utilized for the experimental work. Important background surface layer and solids loading monitoring data will be available for both pilot basins for an eight-month period prior to the scheduled beginning of the experimental program on May 15, 1976.

Recommended Experiments

The following five experiments incorporate practical SSB operational parameters which will yield important data on the optimal operation of the SSBs. This information is considered applicable to the existing SSBs even though the two pilot experimental basins are much smaller in size. During this experimentation, information will continue to be obtained from existing SSB operation and those basins operating in a design mode, which involves loading at 20 pounds volatile solids per 1,000 feet (lb VS/1,000 ft^2), will serve as a control to the experimental work. Information gained from the continual monitoring of existing SSBs under subtask 4.1 of the work plan and the recommended experiments will provide indications as to what might be expected from varying other SSB operational parameters.

Flexibility will be incorporated into all experiments. If it becomes obvious that significant changes are not taking place, or that experimental periods are unnecessarily long or complicated, the work will be adjusted without jeopardizing the observations or invalidating the results obtained. Experiments II and III as well as IV and V will be run concurrently which will result in a substantial savings in time and cost.

Further savings will be realized by having all necessary analytical work conducted at the site of the experimental basins. Depending on the results of Experiment I, surface layer characteristics could be monitored as frequently as every few hours during the remaining experiments. Staff from Environmental Quality Analysts (EQA) will conduct a training session prior to the start of the experimental work for providing guidance to the field personnel in the analytical methods to be utilized. Characteristics to be monitored will include dissolved oxygen, turbidity, temperature, pH, specific conductance and algae count.

In addition to monitoring surface layer characteristics, there will be weekly monitoring of unit area surface odor emissions from the experimental basins during Experiments II through V. Concurrently, basin surface micrometeorology will be evaluated.

Experiment I - Present Conditions. Under a design loading of 20 lb VS/1,000 ft^2, this experiment involves a period of concentrated monitoring of experimental basins east and west to; (1) supply additional information as to the present base case, and (2) provide necessary information in order to determine the sampling frequency for the remaining experiments.

Experiments II and III - Loading at Night and Supernatent Recycle. A period of concentrated monitoring to observe the effects; (1) in the west basin, of mixing digested sludge of 20 lb VS/1,000 ft^2 with five times its volume of basin supernatent prior to its discharge, and (2) in the east basin, of loading only at night at 20 lb VS/1,000 ft^2.

Experiments IV and V - Loading to Failure. A period of concentrated monitoring to observe the effects; (1) in the west basin, of loading to failure by adding anaerobically digested sludge, initially at 40 lb VS/1,000 ft^2 for the first week, then at 20 to 40 lb increments for each additional week for five weeks or until failure is produced, and (2) in the east basin, of using the same loading procedure as in the west basin, but using undigested waste activated sludge (WAS) as the feed. Solids inventories will be made in each basin prior to the start of Experiment III and IV.

Experimental Program Schedule

Although it was originally anticipated that the SSB experimental program would start during the summer of 1975, there is no inherent limitation within the program other than its required completion before the SSB Environmental Impact Report is due at the end of December, 1977. This will allow the program's results to be included in the report. It is anticipated that the experimental program will start shortly after May 15, 1977 and extend through July.

Once the experiments begin they should continue straight through to their conclusion. All cost estimates assume that this continuity will exist. The estimated time requirement for each experiment is as follows:

- Experiment I - one week
- Experiments II and III - five weeks
- Experiments IV and V - five weeks

Program Costs

The following cost estimates are based on 1977 wage schedules:

Project Supervision	$ 2,000.00
Project Manager	8,400.00
Field Personnel	11,124.00
Analysis and Progress Reports	3,860.00
Laboratory Training Session	1,100.00
Miscellaneous Expenses (Travel, Repro., Util.)	1,316.00
Odor Monitoring (EUTEK)	16,300.00
Final Report Preparation	14,000.00
Total costs for subtask 4.2	$58,100.00

DETAIL DESCRIPTION OF WORK - SUBTASK 4.8 - SSB STUDIES

SOLIDS STORAGE BASIN STUDY MANAGEMENT, DATA REDUCTION AND REPORT PREPARATION

At the time of completion of the SRWMP 1975 Solids Study, many questions still remained to be answered regarding the solids storage basins' (SSBs) effect on the environment. The 1975 Solids Study clearly indicated the advantages of using the SSBs as part of the recommended processing and disposal system, but at the same time, it also pointed out the need for the gathering of additional operation and performance information on their effect on atmospheric odors, groundwater pollution and final disposal criteria.

The first seven subtasks of the proposed SSB studies are designed to gather this information. Data obtained from the SSB and groundwater monitoring programs are plotted, thereby allowing for continual evaluation of SSB performance and their effect on groundwater pollution. Quarterly summaries of this data, prepared by SAC, will be provided to the District. To assure efficient use of the existing facilities during the data gathering process and the proper coordination of the various parts of the study requires the entire study to be managed by SAC. In addition to the overall task of data analysis, SAC should also be assigned the task of final report preparation.

The solids program schedule for the SSB studies (subtask 4.8) calls for the study's final report to be submitted at the end of December, 1977. It is expected that this report will provide final recommendations for design and construction of the final 12 SSBs which must be added to the District's sludge processing system to provide for the regional plant's sludge. Present plans call for the regional plant's contract to exclude the construction of these twelve basins. It is expected that the basins will be constructed under a separate contract which will bid during the fall of 1978. This schedule will allow the District, State and Federal authorities six months to review and decide on the final disposition of the SSB issue and allow for the completion of the SSB EIR processes. We believe this time allowance will be adequate for the issue involved.

It is estimated that the cost of this subtask will be $30,400 (including inflation allowances). Of this amount $19,400 is expected to cover the cost of data plotting and analysis and final report preparation with the remaining $11,000, the cost of study management

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 5 - DEDICATED LAND DISPOSAL

Present Federal and State regulatory policy for the disposal of sewage sludge to land is in preliminary draft form. Federal guidelines have recently been issued in the Federal Register of June 3, 1976. As currently written the Environmental Protection Agency's (EPA's) technical bulletin does not recognize dedicated land application of sludge as a means of ultimate sewage sludge disposal. However, the EPA has been urged to revise their bulletin to include this method of disposal and seems to be receptive to the suggestions made.

Commenting on EPA's proposed bulletin the Food and Drug Administration (FDA) supports, in a consensus statement from the United States Department of Agriculture (USDA), cadmium, lead and PCB limits on sewage sludge bound for agricultural land application (see SLUDGE, October 1976). These proposed limits could have been prohibitive had the District chosen to pursue agricultural reuse of sludge in the SSMP.

Until recently, State policy had been somewhat confused due to overlapping proposed regulations of the Solid Waste Management Board (SWMB) and existing Regional Water Quality Control Board (RWQCB) regulations for sanitary landfill disposal. In November, 1976 the California State Department of Health (CSDH) issued, for the SWMB, proposed regulations on handling, disposal and application of sewage sludge to land. Of major significance in these regulations is the distinction of sludge disposal at a landfill and disposal on dedicated land. Amongst those requirements set forth by the CSDH are the following:

> "60475. Sewage solids shall be deposited to land dedicated to perpetuity for use as a repository of sewage sludge only as approved in writing by the Department.
>
> "The wastewater treatment authority shall submit to the Department a report that will describe how land will be prepared before sludge is applied;

> what method will be used to apply the sludge; what rates, in dry weight per acre per year, will be used for application of sludge; and what provisions will be made to monitor the effects of sludge disposal on environmental quality."

Most of the proposed monitoring requirements in these regulations are already an integral part of the dedicated land disposal study in the SSMP. This study has been designed to provide the RWQCB, Federal, State and local health entities with complete data to formulate the prescribed discharge specifications, monitoring and disposal procedures which will completely protect the environment.

The land disposal study involves evaluating various methods of applying stabilized sewage sludge to land dedicated exclusively for such use and monitoring the effects on soil, groundwater and surface water runoff from such applications. For the purpose of this study this work has been divided into the following three subtasks: (1) management and report preparation; (2) site development and sludge spreading, and (3) disposal site monitoring. Work shall be as described below.

DETAIL DESCRIPTION OF WORK

Sacramento Regional County Sanitation District (SRCSD) plans to construct a regional wastewater treatment plant in the vicinity of Freeport which will consolidate existing treatment plants. It is proposed to apply the stabilized sewage sludge produced by this plant annually to nearby land. This dedicated land disposal study will evaluate different methods of sludge application for compatibility with the environment, cost-effectiveness, and the maximum sludge application rate in tons per acre per year that can be safely applied to the land. Monitoring for environmental effects from these applications will be carried out for the full three-year study.

Task Objectives

The experimentation, data gathering and information extraction process will be designed and directed to achieve the following objectives:

1. To measure the base levels of constituents in soils which will be affected by the application of sewage sludge.

2. To monitor during the experimental period transformations and redistribution of sludge solid components to the groundwater and surface runoff. All surface runoff shall be captured and treated at the nearby Central treatment plant.
3. To measure annually the changes in chemical composition and physical properties of the soil receiving sewage sludge applications.
4. To select the sewage sludge application method that will:
   a. Allow for the maximum annual sludge application rate and yet not be limited by undesirable discharge to ground or surface waters. The main advantage of this determination will be the minimizing of the amount of land necessary to dispose of an estimated 22,000-32,000 tons of dry sewage sludge per year.
   b. Be the most cost-effective. Strong consideration will be given to the method which lends itself to automation in sludge application, thereby reducing the number of man-hours required for the sludge disposal operation, provides the most flexibility in handling a range of application rates, and is the most likely to be unaffected by climatological variations.
5. To achieve a nonhazardous working environment by maintaining acceptable public health vector controls.

General Work Plan

Site Description. As shown in Fig. 5.0-1, there are two dedicated land disposal sites (DLDS). The 34-acre land disposal study area has been tentatively chosen due to its immediate availability, its close proximity to the existing SSBs and its ultimate location outside of the regional plant construction site. Similarly, the proposed 166-acre Sacramento Regional Wastewater Treatment dedicated disposal site is also conveniently adjacent to SSB locations, and is outside the regional plant construction

See February 17 Work Plan for Fig. 5.0-1.

site yet within the boundaries of the plant. It is anticipated that this acreage, in combination with that of the dedicated land disposal study area, would supply sufficient land area to accommodate future sludge disposal needs for the next 20 years at application rates of less than 170 tons (dry wt)/acre/year.

The 1975 Solids Study discussed land use in the vicinity of the regional plant. Noncompatible land uses including low density urban, agriculture-recreational, agriculture-urban, and industrial are effectively separated from the DLDS and the regional plant area by a buffer zone established by the district. Physical boundaries such as Franklin Boulevard, Highway I-5 and the Beach Lake Basin also serve to enhance this separation of noncompatible land uses.

A report prepared by SAC in 1975 on flood hazard analysis of the regional plant recommended construction of a levee system to an elevation of 17.5 feet around the entire plant site. The DLDS, though, would not be within the confines of this levee system. However, as pointed out in the 1975 Solids Study, the U.S. Army Corps of Engineers is investigating the use of an area southwest of the regional plant site as a flood retardation basin. As envisioned by the Corps of Engineers the maximum flood pool would extend about 1 mile from the southern boundary of the regional treatment plant area.

Field Studies. Three years will be required to complete the physical tasks of this study. One year will be devoted to sewage sludge application and monitoring for the plow down or direct injection method of application. An additional year will be used to study furrow type spreading, and flooding. A repeat of the most cost-effective type of spreading will occur in the final year. Although sludge spreading operations will terminate in the fall of 1978, monitoring of the environmental effects will continue in early 1979 in order to incorporate into the results of another rainy season.

Soil samples for analysis will be taken annually from inside and outside the disposal site to a depth of four feet.

Runoff from the disposal site will be collected periodically during the rainy season.

Soil solution samples will be collected from within the disposal site after sewage sludge applications and during the rainy season and from outside the disposal site during the rainy season.

Piezometers inside and outside the disposal site will be utilized for recording groundwater levels and for sampling, assuming groundwater is encountered.

Shallow tensiometers located within the disposal site will be used for indicating saturated subsurface soil conditions that could result from sewage sludge application.

Creek water flowing through the treatment plant site will be sampled monthly at upstream and downstream locations.

Modifications. It is recognized that modifications to this original work plan may be advisable at some point in the study. These modifications may take the form of altering the application or sampling program or the analytical parameters sought, or both.

Major modifications will be made only with concurrence of District and SAC sludge program management because such changes may affect other aspects of the overall sludge disposal program. However, it should be emphasized at this point that the study costs may be considered maximal. Therefore, any modifications to the experimental program are expected to be able to be made within the indicated total study cost. Total estimated cost for the dedicated land disposal study is $605,700.

Task Organization. Table 5.0-1 is an organizational chart identifying the relationship between management and funding agencies and the three subdivisions of the task. The subtasks are named together with the identity of their leaders or coordinators.

Work Assignments. Table 5.0-2 identifies major work assignments and lists responsibility for completion to one of the subtasks. It should be emphasized that some work will be accomplished jointly by representatives of two or at times perhaps all of the subtasks. Table 5.0-3 lists the media which will be sampled; assigns subtask responsibility for sample collection, preparation and splitting; identifies the analytical parameters sought in each media sample; and assigns responsibility for obtaining and reporting the laboratory analytical data. Table 1.0-3 lists analytical responsibility of subtask and sample medium.

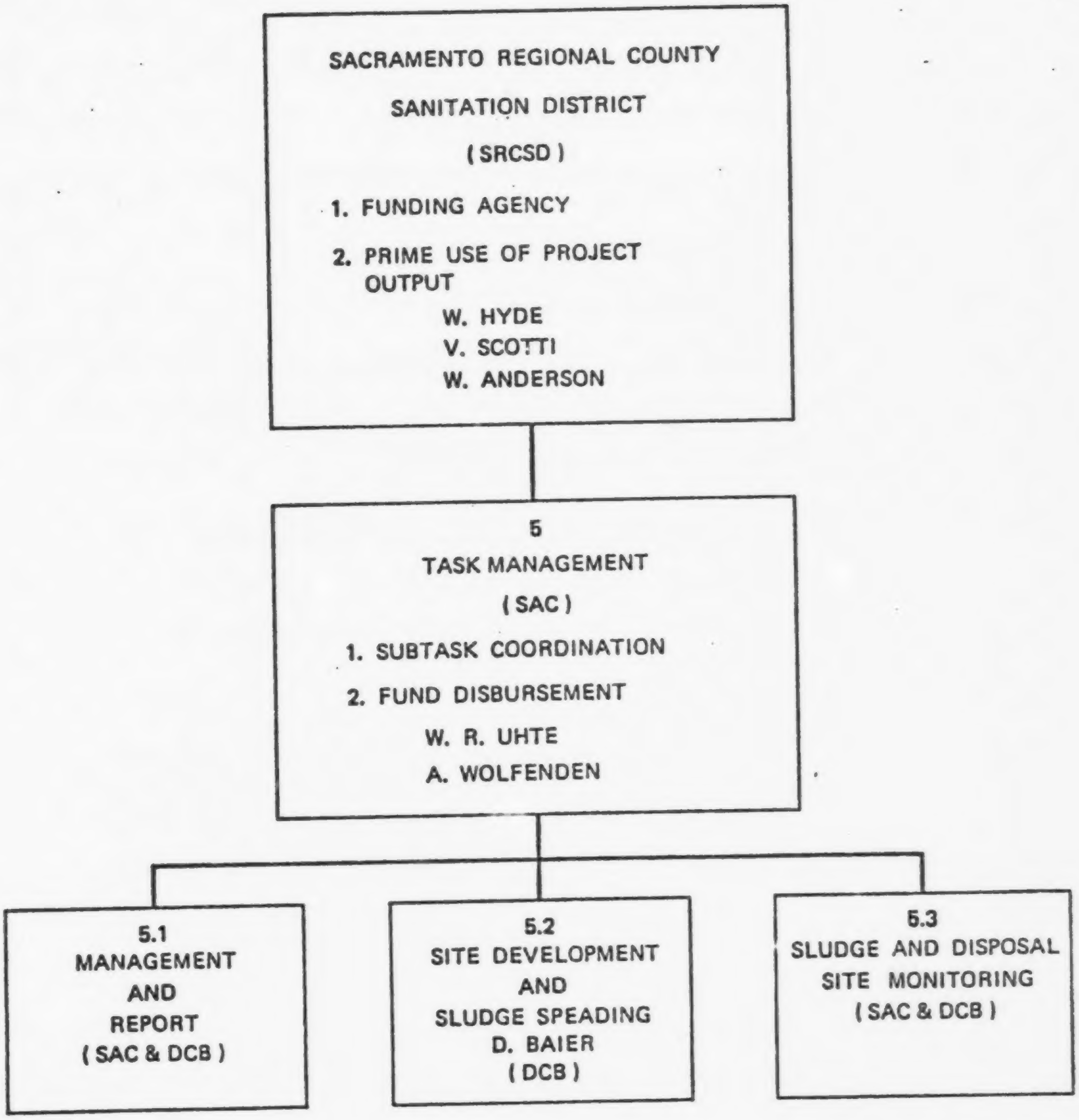


Table 5.0-1. Dedicated Land Disposal Study Task Organizational Chart

Table 5.0-2 Dedicated Land Disposal Study - Major Work Assignments

Work No.	Description of Work	Assignment[a]
1	Land and spreading equipment requisition	DCB
2	Soil sampling-verification of sufficient hardpan	DCB
3	Final site selection	DCB
4	Site design and preparation for sludge application methods	DCB
5	Pre-disposal baseline soil sampling	DCB
5a	Annual soil sampling	DCB
6	Sewage sludge sampling and preparation	DCB
7	Installation of soil solution, plot runoff, and groundwater sampling equipment	DCB
8	Sewage sludge application, application rate measurement and soil incorporation of sewage sludge	DCB
9	Soil solution, groundwater, surface runoff, and creek water sampling and splitting	DCB (SAC)
10	Soil sample preparation and splitting	DCB
11	Groundwater level recording	DCB
12	Sewage sludge, soil, soil solution, groundwater, runoff and creek water analysis	(See Table 5.0-3)
13	Data compilation, reduction, interpretation and reports	DCB
14	Planning and general supervision	DCB
15	Task management and coordination	SAC

[a] ( ) parenthesis indicates cooperative activity by the subtask but not prime responsibility for work.

Table 5.0-3. Dedicated Land Disposal Sampling and Laboratory Analytical Data Reporting Responsibility-Subtask 5.3

Sample	Sampling, sample preparation, sample splitting (when required)	DCB subtask	SAC subtask
Sewage sludge (harvested)	DCB	None	Alkalinity, Cl, NH_3-N, sol-P, SO_4, TP, TN, B, Ca, Mg, K, Na, Zn, Cu, Cr, As, Pb, Ni, Ag, Cd, Hg, Be, Mo, Se, PCBs 1242 & 1254, tech chlordane & other pesticide residues, Zn/Cd ratio, TS, VS, pH, EC
Soil	DCB	pH, EC, NO_3-N, PO_4-P, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH, B, Cu, Zn, Cd, Ni, CEC, TKN, NH_4, TOC, chl. hydrocarbons and PCBs	None
Soil solution	DCB	EC, NO_3-N, SO_4, HCO_3+CO_3, Cl, Ca, Mg, K, Na, pH, PO_4-P, B, Zn, Cd, chl. hydrocarbons and PCBs	None
Groundwater	DCB	Same as for soil solution	None
Surface runoff	DCB	EC, pH, turbidity, TKN, NO_3-N, NH_3-N, TP, Cl, NH_4, Zn, Cu, Cd, Ni, Pb, Hg, chl. hydrocarbons and PCBs	None
Morrison Creek water	SAC	None	Zn, Cd, Cu, Ni, Pb, Hg, TKN, NO_3-N, NH_3-N, TPO_4, pH, EC, turbidity, chl. hydrocarbons and PCBs, T. coli., F. coli., and F. strep.

DETAIL DESCRIPTION OF WORK - SUBTASK 5.2 - DEDICATED LAND DISPOSAL STUDY - SITE DEVELOPMENT AND SLUDGE SPREADING

Description of Subtask Work

Work of this subtask will consist of development of the dedicated land disposal study area and of testing and evaluating three methods of sewage sludge application. As soon as the study is authorized it is intended that several soil samples will be taken from the study area to assure the existence of sufficient hardpan throughout the site to provide the necessary isolation between the surface applied waters and existing groundwaters. If the site does not reasonably satisfy this requirement, a more appropriate site will be chosen.

Three methods of sludge application will be examined during the course of the work. Each year each method will be utilized to apply up to 2,000 tons (dry wt) in the liquid state to the dedicated land disposal study area shown in Fig. 5.0-1 at rates between 150 and 200 tons (dry wt)/acre/year. Liquid stabilized sludge will be pumped directly from the solids storage basins (SSBs) at about five percent solids by the district's "Mudcat" dredge to the land disposal site during the four summer months with the highest average of sunshine and maximum amount of evaporation (June-September). It is estimated this period will contain approximately 80 working days.

Due to the minimal site preparation required and the ready availability of the necessary equipment. the study will commence during the summer of 1976 using the plowdown (direct injection) method of sludge application. In this way, sufficient time will be available to design and prepare the site for the furrow and flooding type spreading during 1977 and a repeat of the most cost-effective type of spreading in 1978.

Subtask Budget Estimate

The estimated total budget for subtask 5.2 from the spring of 1976 to the fall of 1978 is $246,500 (including inflation allowances). Included within this total are costs for site preparation and sludge spreading, including all necessary equipment rental.

SEWAGE SLUDGE MANAGEMENT PROGRAM

TASK 6 - MISCELLANEOUS USE DETERMINATIONS

Miscellaneous use determinations involve the following two subtasks: (1) a microbiological study including a monitoring program capable of meeting proposed federal, state and local environmental and public health requirements, determining the effectiveness of the proposed sewage sludge processing system in destroying selected index organisms and providing direction towards sludge management practices which will achieve a cost-effective, public health hazardless, sludge disposal system, and (2) a virus study including a monitoring program capable of meeting the same criteria for virus as outlined above for microbiological organisms.

Task Organization

Table 6.0-1 is an organizational chart identifying the relationship between management and funding agencies and the two subdivisions of the task. The subtasks are named together with the identity of their leaders or coordinators.

Work Assignments

Table 6.0-2 identifies major work assignments and lists responsibility for completion to one of the subtasks. It should be emphasized that some work will be accomplished jointly by representatives of two or at times perhaps all of the assignees. Table 6.0-3 lists the media which will be sampled; assigns subtask responsibility for sample collection, preparation and splitting; identifies the microorganism sought in each media sample; and assigns subproject responsibility for obtaining and reporting the laboratory analytical data.

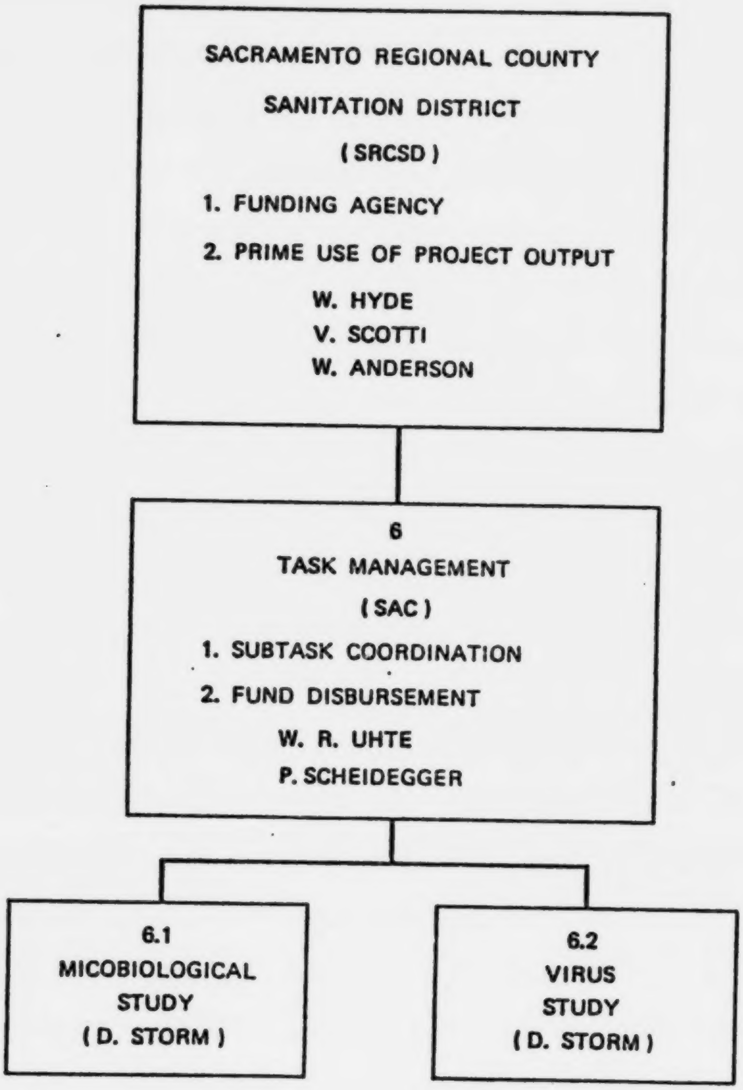


Table 6.0-1. Miscellaneous Use Determinations Task Organizational Chart

Table 6.0-2 Miscellaneous Use Determinations - Major Work Assignments

Work No.	Description of Work	Assignment
1	SSB sludge, raw sludge, digested sludge, harvested sludge, soil, surface runoff and creek water sampling and splitting	Storm & SAC
2	SSB sludge, raw sludge, digested sludge, harvested sludge, soil, surface runoff and creek water analysis	(See Table 6.0-3)
2a	Parasitic helminths and pathogenic protozoans determinations	Thesis
2b	Index bacteria determinations	Quiger Lab
2c	Viral isolations and quantitative analysis	Quinn
3	Data correlation with EBMUD soil enrichment studies	Storm
4	Direct supervision	Storm
5	Data compilation, reduction, interpretation and reports	Storm
6	Task management and coordination	SAC

Table 6.0-3. **Miscellaneous Use Determinations, Sampling and Laboratory Data Responsibility-Subtasks 6.1 and 6.2**

Sample type	Sampling, sample preparation, sample splitting (when required)	DS subtask			
		Presence and quantitation for			
		Helminths	Bacteria[a]	Protozoans	Hepatitis Type B Antigen
SSB sludge	DS	X[b]	X	X	X
Raw sludge	DS	X	X	X	X
Digested sludge	DS	X	X	X	X
Harvested sludge	DS	X	X	X	X[c]
Sludge treated soils	DS	X	X	X	-
Untreated soils	DS	X	X	X	-
Surface runoff	DS	X	X	X	X
Creek water	DS	X	X	X	X

[a] Bacteria - Salmonella sp., Shigella sp., Fecal coliform, and Fecal streptococci.

[b] X indicates a laboratory determination is run.

[c] - indicates no laboratory determination.

SECTION 2

CONTRACTUAL ARRANGEMENT

CONTRACTUAL ARRANGEMENT

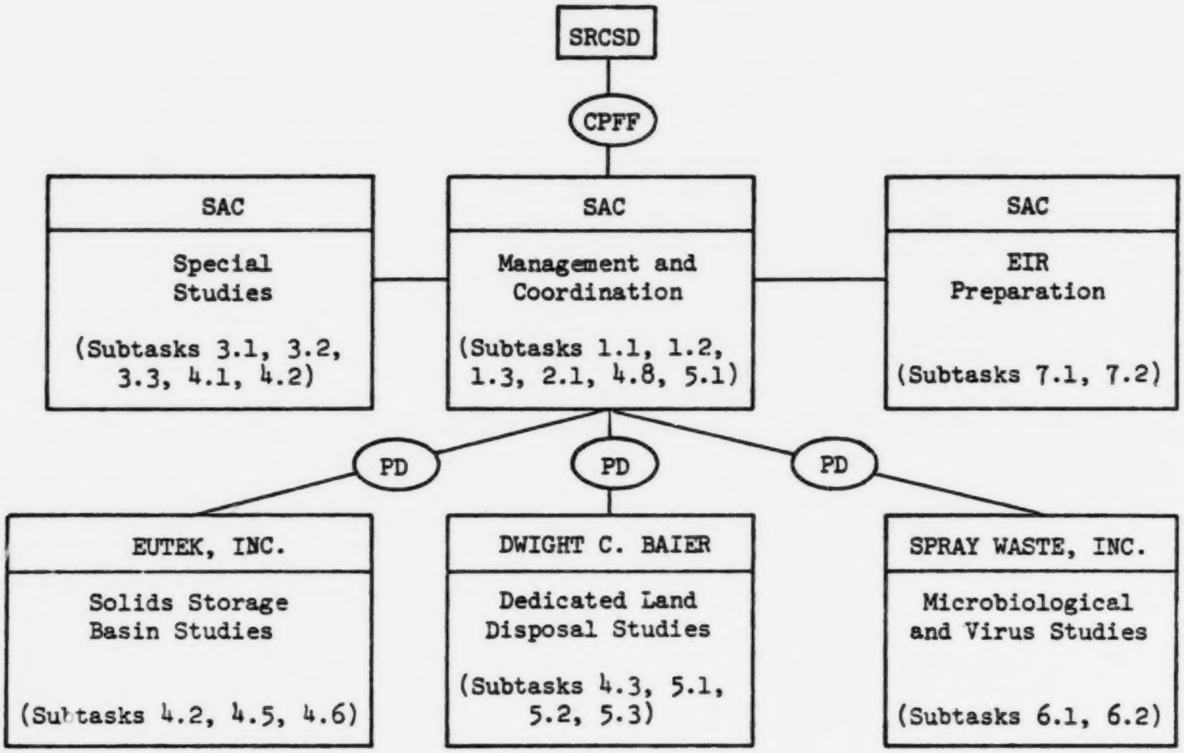
The contract amendment for all engineering services for the Sewage Sludge Management Program shall be a single Cost Plus Fixed Fee (CPFF) amendment. This amendment covers all work to be conducted on or after November 1, 1976 through the end of the program, projected for July 1, 1980.

Figure 3 indicates the contractual and fee arrangements that will be utilized. Three primary subcontractors will be employed to conduct portions of the program. EUTEK, Inc. will conduct much of the solids storage basins studies. Dwight C. Baier, agricultural consultant, will conduct the dedicated land disposal studies. Spray Waste, Inc. will conduct microbiological and virus studies. These three subcontractors will continue to work on a per diem basis. Selection of these subcontractors was approved on May 18, 1976 by the Program Administration Team of the Sacramento Regional Wastewater Management Program. The cost basis and estimated cost of the services to be provided by subcontractors is set forth in this proposal.

Any other professional subcontractors required in the conduct of this program will be retained by SAC on a per diem basis. It is not expected that the individual cost for any additional subcontractor will exceed $10,000.

FIGURE 3

CONTRACTUAL AND FEE ARRANGEMENTS
FOR SEWAGE SLUDGE MANAGEMENT PROGRAM


SRCSD
CPFF
SAC
Special Studies
(Subtasks 3.1, 3.2, 3.3, 4.1, 4.2)
SAC
Management and Coordination
(Subtasks 1.1, 1.2, 1.3, 2.1, 4.8, 5.1)
SAC
EIR Preparation
(Subtasks 7.1, 7.2)
PD
PD
PD
EUTEK, INC.
Solids Storage Basin Studies
(Subtasks 4.2, 4.5, 4.6)
DWIGHT C. BAIER
Dedicated Land Disposal Studies
(Subtasks 4.3, 5.1, 5.2, 5.3)
SPRAY WASTE, INC.
Microbiological and Virus Studies
(Subtasks 6.1, 6.2)

CPFF - COST PLUS FIXED FEE (COST REIMBURSEMENT) PORTION OF CONTRACT AMENDMENT

PD - PER DIEM PORTION OF CONTRACT AMENDMENT

SECTION 3

SUMMARY OF PROPOSAL PRICE

The attached EPA Form 5700-41 indicates the total price for this proposal for the Sewage Sludge Management Program. Attachments A, B, and C provide a summary of the cost data, and the remaining sections of this proposal provide detailed support information.

Table 3 has been provided to give a breakdown of the cost by subtask. Amounts have been rounded to the nearest hundred dollars so the total cost does not correspond to precisely with the total price on line 12 of the Form 5700. Table 3 also lists the costs prior to November 1, 1976, which are not a part of this proposal. Thus, the third column in Table 3 summarizes the current total estimate of cost of the Sewage Sludge Management Program.

To provide a means of comparing the current cost with earlier estimates, the fourth and fifth columns have been included. Column four gives the program cost as presented in the February 1976 Work Plan, while the last column shows the costs estimated at the time of the last interim job authorization (October 1976). Table 1 in Section 1 itemizes the $138,200 increase in cost occurring between the February 1976 Work Plan and the October 1976 interim job authorization. The major reasons for cost changes between the October 1976 estimate and the current estimate have been discussed in Section 1 of this proposal and are further detailed in Sections 4 through 7.

Work under this proposal will be conducted under SAC job numbers J231 and J232. A listing of the subaccounts are shown in Table 3. Upon execution of the contract amendment covering this proposal, the interim SSMP job number J222 will be closed.

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I-GENERAL

1. GRANTEE
Sacramento Regional County Sanitation District

2. GRANT NUMBER
C-06-0938-01-0

3. NAME OF CONTRACTOR OR SUBCONTRACTOR
Sacramento Area Consultants

4. DATE OF PROPOSAL
December 10, 1976

5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR (Include ZIP code)
1101 "R" Street
Sacramento, CA 95814

6. TYPE OF SERVICE TO BE FURNISHED
Engineering services for the Sewage Sludge Management Program

PART II-COST SUMMARY

7. DIRECT LABOR (Specify labor categories)	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Labor rates used for all SAC work are shown in Attachment A. Detailed breakdown of labor is shown in Attachment A, Section 4		$	$152,078.60	
DIRECT LABOR TOTAL:				$ 152,078.60

8. INDIRECT COSTS (Specify indirect cost pools)	RATE	× BASE =	ESTIMATED COST	TOTALS
Direct labor x 1.32		$	$	
INDIRECT COSTS TOTAL:				$ 200,743.75

9. OTHER DIRECT COSTS

a. TRAVEL See Attachment B	ESTIMATED COST
(1) TRANSPORTATION	$
(2) PER DIEM	$
TRAVEL SUBTOTAL:	$ 9,274.20

b. EQUIPMENT, MATERIALS, SUPPLIES (Specify categories)	QTY	COST	ESTIMATED COST
See Attachment B		$	$
EQUIPMENT SUBTOTAL:			215,657.33

c. SUBCONTRACTS	ESTIMATED COST
See Attachment B	$
SUBCONTRACTS SUBTOTAL:	$744,689.96

d. OTHER (Specify categories)	ESTIMATED COST
	$
OTHER SUBTOTAL:	$
e. OTHER DIRECT COSTS TOTAL:	$ 969,621.29

10. TOTAL ESTIMATED COST	$1,322,443.64
11. PROFIT See Attachment C	$ 99,531.54
12. TOTAL PRICE	$1,421,975.18

Form Approved
OMB No. 158-R0144

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES *(Indicate basis for price comparison)*	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If "Yes" give name address and telephone number of reviewing office)*

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41 CFR 1-15.4

14c.

This proposal is submitted for use in connection with and in response to *(1)* SRCSD Request for Proposal dated November 29, 1976. This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* December 10, 1976 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) December 10, 1976
DATE OF EXECUTION

SIGNATURE OF PROPOSER

General Manager
Sacramento Area Consultants
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

ATTACHMENT A
SUMMARY OF DIRECT LABOR RATES 1976-1981[1]

GRADE CODE		DIRECT LABOR RATES (dollars/hour)					
	PROFESSIONAL STAFF	1976	1977	1978	1979	1980	1981
10	Executive Engineer	18.88	20.20	21.62	23.13	24.75	26.48
11	Chief Engineer	16.85	18.03	19.29	20.64	22.09	23.64
12	Managing Engineer	15.39	16.47	17.62	18.85	20.17	21.58
13	Supervising Engineer	13.97	14.95	15.99	17.11	18.31	19.59
14	Principal Engineer	12.50	13.38	14.31	15.31	16.38	17.53
15	Senior Engineer	10.99	11.76	12.58	13.46	14.41	15.42
16	Engineer	9.61	10.28	11.00	11.77	12.60	13.48
17	Associate Engineer	8.10	8.67	9.27	9.92	10.62	11.36
18	Assistant Engineer	6.90	7.38	7.90	8.45	9.04	9.67
19	Engineering Aide	5.73	6.13	6.56	7.02	7.51	8.04
	TECHNICAL STAFF						
31	Chief Draftsman	10.99	11.76	12.58	13.46	14.41	15.42
32	Supervising Draftsman	9.61	10.28	11.00	11.77	12.60	13.48
33	Lead Draftsman	8.10	8.67	9.27	9.92	10.62	11.36
34	Senior Draftsman	6.90	7.38	7.90	8.45	9.04	9.67
35	Draftsman	5.73	6.13	6.56	7.02	7.51	8.04
36	Assistant Draftsman	4.74	5.07	5.43	5.81	6.21	6.65
37	Draftsman Trainee II	3.88	4.15	4.44	4.75	5.09	5.44
38	Draftsman Trainee I	3.19	3.41	3.65	3.91	4.18	4.47
41	Engineering Technician	8.10	8.67	9.27	9.92	10.62	11.36
	ADMINISTRATIVE STAFF						
64	Office Administrator	6.90	7.38	7.90	8.45	9.04	9.67
65	Typist IV	5.73	6.13	6.56	7.02	7.51	8.04
66	Typist III	4.74	5.07	5.43	5.81	6.21	6.65
67	Typist II	3.88	4.15	4.44	4.75	5.09	5.44
68	Typist I	3.19	3.41	3.65	3.91	4.18	4.47

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[1] Costs are based on the rates approved as part of Amendment VII, escalated at a rate of seven percent per year. These rates are used for all SAC work.

ATTACHMENT B

SUMMARY OF OTHER DIRECT COSTS

		Cost ($)
A.	Travel[1]	9,274.20
B.	Equipment, Materials, Supplies[1]	
	Toll calls	2,150.00
	Expendable supplies	3,140.00
	Copying and Printing	45,670.00
	Equipment and miscellaneous costs	27,191.33
	Laboratory tests	137,506.00
	Subtotal	215,657.33
C.	Subcontracts	
	Total of miscellaneous contracts less than $10,000 each[1]	19,524.00
	Dwight C. Baier[2]	350,794.62
	Spray Waste, Inc.[3]	159,621.84
	EUTEK, Inc.[4]	214,749.50
	Subtotal	744,689.96

[1] See Section 4 for detail
[2] See Section 5 for detail
[3] See Section 6 for detail
[4] See Section 7 for detail

TABLE 3

SEWAGE SLUDGE MANAGEMENT PROGRAM
COST SUMMARY (dollars)

Job Number (Subaccount)	Task Number and Title	Current Estimate			2/76 Work Plan Estimate	10/76 Authorization Estimate
		Prior to 11/1/76	After 11/1/76	Total		
	Task 1 - Program Management	80,000	83,900	163,900	137,000	149,500
J231A	Subtask 1.1 - Authorization Preparation and 1975 Studies	70,300	8,100	78,400	66,300	78,800
J231B	Subtask 1.2 - 1976-1979 Studies	9,700	50,600	60,300	46,000	46,000
J231C	Subtask 1.3 - Final Report Preparation	0	25,200	25,200	24,700	24,700
	Task 2 - Regulatory Agency Coordination	2,100	9,600	11,700	10,000	10,000
J231D	Subtask 2.1 - Liaison and Special Reports	2,100	9,600	11,700	10,000	10,000
	Task 3 - Source Survey - Phase I	0	27,900	27,900	25,000	25,000
J231E	Subtask 3.1 - Raw Sludge Studies	0	14,200	14,200	12,000	12,000
J231F	Subtask 3.2 - Influent-Effluent Studies	0	5,400	5,400	5,000	5,000
J231G	Subtask 3.3 - Preparation of Progress Report	0	8,300	8,300	8,000	8,000
	Task 4 - Solids Storage Basin (SSB) Studies	217,400	388,600	606,000	426,000	551,700
J231H	Subtask 4.1 - Continuing Solids Storage Basin Operation and Performance Evaluation Program	9,700	32,000	41,700	42,000	42,000
J231J	Subtask 4.2 - Solids Storage Basin Experimental Work	0	58,100	58,100	75,000	75,000
J231K	Subtask 4.3 - Continuing SSB Groundwater Monitoring Program and Site Engineering Work	6,500	26,000	32,500	34,000	37,500

TABLE 3
(continued)

SEWAGE SLUDGE MANAGEMENT PROGRAM
COST SUMMARY (dollars)

Job Number (Subaccount)	Task Number and Title	Current Estimate			2/76 Work Plan Estimate	10/76 Authorization Estimate
		Prior to 11/1/76	After 11/1/76	Total		
	Task 4 - Solids Storage Basin (SSB) Studies (continued)					
J231L	Subtask 4.5 - Solids Storage Basin Source Odor Control Study	134,800	139,400	274,200	102,000	222,500
J231M	Subtask 4.6 - Development of Odor Criteria for Large Emission Areas	59,200	102,700	161,900	143,000	144,700
J231N	Subtask 4.8 - Solids Storage Basin Study Management, Data Reduction, and Report	7,200	30,400	37,600	30,000	30,000
	Task 5 - Dedicated Land Disposal Study	97,900	507,800	605,700	598,000	598,000
J231P	Subtask 5.1 - Management and Report	16,600	123,600	140,200	123,000	123,000
J231R	Subtask 5.2 - Site Development and Sludge Spreading	61,100	185,400	246,500	210,000	210,000
J231S	Subtask 5.3 - Sludge and Disposal Site Monitoring	20,200	198,800	219,000	265,000	265,000
	Task 6 - Miscellaneous Use Determinations	13,600	176,000	189,600	226,000	226,000
J231T	Subtask 6.1 - Microbiological Study	6,800	83,000	89,800	131,000	131,000
J231U	Subtask 6.2 - Virus Study	6,800	93,000	99,800	95,000	95,000
	Task 7 - Environmental Impact Reports	0	228,200	228,200	0	0
J232A	Subtask 7.1 - Solids Storage Basin EIR	0	118,600	118,600	0	0
J232B	Subtask 7.2 - Dedicated Land Disposal EIR	0	109,600	109,600	0	0
	TOTAL	411,000	1,422,000	1,833,000	1,422,000	1,560,000

ATTACHMENT C

SAC PROFIT COMPUTATION

Labor Related	
0.185 (direct labor + indirect costs) 0.185 (152,078.60 + 200,743.75)	$65,272.12
Profit on Direct Costs Other than Subcontracts	
0.07 (224,931.53)	$15,745.21
Profit on Subcontracts	
Profit on subcontracts is limited to 7 percent of 20 percent of total estimated cost.	
0.07 (0.20) {total estimated cost (line 10)}	
0.07 (0.20) (1,322,443.64)	$18,514.21
	$99,531.54

SECTION 4

SACRAMENTO AREA CONSULTANTS' PROPOSAL

This section of the proposal details the cost for work to be performed directly by Sacramento Area Consultants. The attached EPA Form 5700-41 summarizes the direct labor, indirect costs, and other direct costs. The table on page A1 summarizes SAC direct labor costs by year. The manhour summaries on pages A2 through A6 give an annual listing of manhours by subtask. On pages A8 through A49 detailed breakdowns of the manhours for each subtask are provided.

Attachments B, C, and D summarize other direct costs.

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE
Sacramento Regional County Sanitation District

2. GRANT NUMBER
C-06-0938-01-0

3. NAME OF CONTRACTOR OR SUBCONTRACTOR
Sacramento Area Consultants

4. DATE OF PROPOSAL
December 10, 1976

5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)*
1101 "R" Street
Sacramento, California 95814

6. TYPE OF SERVICE TO BE FURNISHED
Engineering services for the Sewage Sludge Management Program.

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
See Attachment A		$	$152,078.60	
DIRECT LABOR TOTAL:				$152,078.60
8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	
Direct labor x 1.32		$	$	
INDIRECT COSTS TOTAL:				$200,743.75
9. OTHER DIRECT COSTS				
a. TRAVEL See Attachment B			ESTIMATED COST	
(1) TRANSPORTATION			$	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$ 9,274.20	
b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	
See Attachment C		$	$	
EQUIPMENT SUBTOTAL:			215,657.33	
c. SUBCONTRACTS			ESTIMATED COST	
See Attachment D			$	
SUBCONTRACTS SUBTOTAL:			$ 19,524.00	
d. OTHER *(Specify categories)*			ESTIMATED COST	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:			$	$244,455.53
10. TOTAL ESTIMATED COST				$597,277.88
11. PROFIT				$ 82,384.02
12. TOTAL PRICE				$679,661.90

EPA Form 5700-41 (2-76)

PAGE 1 OF 5

ATTAC ENT A

DIRECT LABOR SUMMARY

Grade Code	1976			1977			1978			1979			1980		
	Hrs.	Rate ($)	Cost ($)	Hrs.	Rate ($)	Cost ($)	Hrs.	Rate ($)	Cost ($)	Hrs.	Rate ($)	Cost ($)	Hrs.	Rate ($)	Cost ($)
10				97	20.20	1,959.40	51	21.62	1,102.62	92	23.13	2,129.80	40	24.75	990.00
11	16	16.85	269.60	84	18.03	1,514.52	72	19.29	1,388.88	56	20.64	1,155.84			
12	220	15.39	3,385.80	900	16.47	14,823.00	357	17.62	6,290.34	446	18.85	8,407.10	44	20.17	887.48
13				110	14.95	1,644.50	18	15.99	287.82	100	17.11	1,711.00	12	18.31	219.72
15				847	11.76	9,960.72	225	12.58	2,830.50	628	13.46	8,452.88	192	14.41	2,766.72
16	80	9.61	768.80	922	10.28	9,478.16	146	11.00	1,606.00	748	11.77	8,803.96	140	12.00	1,764.00
17	282	8.10	2,284.20	2,909	8.67	25,221.03	756	9.27	7,008.12	580	9.92	5,753.60			
33				32	8.67	277.44				32	9.92	317.44			
34				144	7.38	1,062.72				20	8.45	169.00			
35				268	6.13	1,642.84	32	6.56	209.92	228	7.02	1,600.56	32	7.51	240.32
36										8	5.81	46.48			
65	70	5.73	401.10	328	6.13	2,010.64	132	6.56	865.92	158	7.02	1,109.16			
66										12	5.81	69.72			
67				678	4.15	2,813.70	194	4.44	861.36	564	4.75	2,679.00	180	5.09	916.20
TOTAL			7,109.50			72,408.64			22,370.48			42,405.54			7,784.44

Total Direct Labor (1976-1980) = $152,078.60

ATTACHMENT B

SUMMARY OF OTHER DIRECT COSTS

		Cost ($)
A.	Travel[1]	9,274.20
B.	Equipment, Materials, Supplies[1]	
	Toll calls	2,150.00
	Expendable supplies	3,140.00
	Copying and Printing	45,670.00
	Equipment and miscellaneous costs	27,191.33
	Laboratory tests	137,506.00
	Subtotal	215,657.33
C.	Subcontracts	
	Total of miscellaneous contracts less than $10,000 each[1]	19,524.00
	Dwight C. Baier[2]	350,794.62
	Spray Waste, Inc.[3]	159,621.84
	EUTEK, Inc.[4]	214,749.50
	Subtotal	744,689.96

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[1] See Section 4 for detail
[2] See Section 5 for detail
[3] See Section 6 for detail
[4] See Section 7 for detail

ATTACHMENT C

SAC PROFIT COMPUTATION

Profit is calculated on the basis of the profit policy negotiated with the District.

Labor Related

0.185 (direct labor + indirect costs)	
0.185 (152,078.60 + 200,743.75)	$65,272.12

Profit on Direct Costs Other than Subcontracts

0.07 (224,931.53)	$15,745.21

Profit on Subcontracts

Profit on subcontracts is limited to 7 percent of 20 percent of total estimated cost.

0.07 (0.20) {total estimated cost (line 10)}	
0.07 (0.20) (1,322,443.64)	$18,514.21
	$99,531.54

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK 1976 Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1.1		4	100				80	40										32			
1.2		12	36															8			
2.1			8															4			
4.1			16					16													
4.5			18					34										4			
4.6			24					16										4			
4.8								60										12			
5.1								100													
5.3								16													
6.1			14															4			
6.2			4															2			
(1976) TOTALS		16	220				80	282										70			

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK 1977 Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1.2		72	216															96			
2.1			36					36										12			
3.1								140													
3.2								60													
3.3			20					240				12						16			
4.1			96					144													
4.2			135					791					104					82			
4.5			120					102										16			
4.6			8					16										2			
4.8	8	12	48					660				20	40					80			
5.1								600													
5.3								96													
6.1			36					12										12			
6.2			24					12										12			
7.1	89		161	110		847	922							268						678	
(1977) TOTALS	97	84	900	110		847	922	2909				32	144	268				328		678	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK 1978 Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1.2		72	216															96			
2.1			36					36										12			
5.1								600													
5.3								96													
6.1			36					12										12			
6.2			24					12										12			
7.1	51		45	18		225	146							32						194	
(1978) TOTALS	51	72	357	18		225	146	756						32				132		194	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK 1979 Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1.2		36	108															48			
1.3	8	20	70					380				16	20		8			58	12		
2.1			36					36										12			
4.3			20				80					16						16			
5.1								100													
5.3								40													
6.1			36					12										12			
6.2			24					12										12			
7.2	84		152	100		628	668							228						564	
(1979) TOTALS	92	56	446	100		628	748	580				32	20	228	8			158	12	564	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK 1980 Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
7.2	40		44	12		192	140							32						180	
(1980) TOTALS	40		44	12		192	140							32						180	

MANHOUR SUMMARY November 1, 1976 - December 31, 1976
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Program Management
Sub-task 1.1 - SWRCB Work Plan Change and Additional Background Information

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Make work plan changes requested by SWRCB																					
. Draft write-up		4	20				80														
. Draft typing																		16			
Develop additional background information																					
. Draft write-up			80					40													
. Draft typing																		16			
(1976) TOTALS		4	100				80	40										32			

MANHOUR SUMMARY November 1, 1976 - June 30, 1979
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Program Management

Sub-task 1.2 - On-going Program

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Manhours per month																					
Coordination of all aspects of SSMP		6	18																		
Typing of letters for management																		4			
Manhours per year:																					
1976 (2 months)		12	36															8			
1977 (12 months)		72	216															96			
1978 (12 months)		72	216															96			
1979 (6 months)		36	108															48			
TOTALS		192	576															248			

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MANHOUR SUMMARY July 1, 1979 - September 30, 1979
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Program Management

Sub-task 1.3 - Final Report Preparation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Drafting report			30					240													
Rough typing and drafting												16	16	4	4			8	12		
Draft Review - In-house			20					80													
Preliminary draft typing													4		4			20			
SAC Review	8	20	10					40													
Final draft typing																		10			
District Review			10					20													
Final typing																		20			
TOTALS	8	20	70					380				16	20	4	8			58	12		

MANHOUR SUMMARY November 1, 1976 - June 30, 1979
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Regulatory Agency Coordination

Sub-task 2.1 - Liaison and Special Reports

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Meetings, correspondence, and tours for regulatory agencies																					
Manhours per year:																					
1976			8															4			
1977			36					36										12			
1978			36					36										12			
1979			36					36										12			
TOTALS																					

MANHOUR SUMMARY 1977
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Source Survey - Phase I
Task 3

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
3.1 Raw Sludge Studies								140													
3.2 Influent/Effluent Studies								60													
3.3 Prep. of Progress Report			20					240				12						16			
(1977) TOTALS			20					440				12						16			

MANHOUR SUMMARY November 1, 1976 - December 31, 1977
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SSB Operation and Performance

Sub-task 4.1 - Evaluation and Monitoring

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1976																					
. SSB Evaluation and Monitoring			16					16													
1977																					
. Quarterly sampling of SSB solids								48													
. SSB evaluation and monitoring			96					96													
(1977) Subtotal			96					144													
TOTALS																					

512

MANHOUR SUMMARY May - July, 1977
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SSB Studies

Sub-task 4.2 - Experimental Work

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Experiment I																					
. Project supervision			4																		
. Project management								32													
. Analysis & progress reports			1					8					4					2			
Experiments II and III																					
. Project supervision			20																		
. Project management								160													
. Analysis & progress reports			5					40					20					10			
Experiments IV and V																					
. Project supervision			20																		
. Project management								160													
. Analysis & progress reports			5					40					20					10			
Laboratory orientation								13													
Final report preparation			80					338					60					60			
. (1977) TOTALS			135					791					104					82			

MANHOUR SUMMARY 1979
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SSB Groundwater Monitoring and Site Engineering

Sub-task 4.3 - Site Engineering

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Review of program and development of site engineering needs			20					80				16						16			
(1979) TOTALS			20					80				16						16			

MANHOUR SUMMARY November 1, 1976 - June 30, 1977
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SSB Source Odor Control Study

Sub-task 4.5 - Mixer & Strainer Operation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1976																					
· Mixer and strainer supervision								18													
· Management and coordination of subcontractor's			18																		
activities and reports								16										4			
1976 Total			18					34										4			
1977																					
· Mixer and strainer supervision								30													
· Management and coordination of subcontractor's			120																		
activities and reports								72										16			
1977 Total			120					102										16			
TOTALS																					

352<

MANHOUR SUMMARY November 1, 1976 - January 31, 1977
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SSB Development of Large Area Emission Odor Criteria

Sub-task 4.6 - Management and Coordination

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1976																					
. Management and coordination of subcontractor's activities and reports			24					16										4			
1977																					
. Management and coordination of subcontractor's activities and reports			8					16										2			
TOTALS																					

MANHOUR SUMMARY November 1, 1976 - December 31, 1976
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SSB Study Management, Data Reduction, and Report Preparation

Sub-task 4.8 - Management

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Management of SSB Program								60										12			
(1976) TOTALS								60										12			

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MANHOUR SUMMARY 1977
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

SSB Study Management,
TASK Data Reduction, and Report Preparation

Sub-task 4.8 - Management and Report Preparation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Management of SSB Program								360										48			
Preparation of Draft Final Report		8	32					240				20	40					16			
Draft Review	8	4	16					40													
Final Report Preparation								20										16			
(1977) TOTALS	8	12	48					660				20	40					80			

568

MANHOUR SUMMARY November 1, 1976 - June 1, 1979
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Dedicated Land Disposal Study

Sub-task 5.1 - Overall Management and Coordination

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Overall management and coordination of monitoring operation																					
Manhours per year:																					
1976								100													
1977								600													
1978								600													
1979								100													
TOTALS																					

MANHOUR SUMMARY November 1, 1976 - June 1, 1979
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Dedicated Land Disposal Study

Sub-task 5.3 - Creek Water Sampling

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Sampling and travel time required for creek sampling																					
Manhours per year:																					
1976								16													
1977								96													
1978								96													
1979								40													
TOTALS																					

MANHOUR SUMMARY November 1, 1976 - August 1, 1979*
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Miscellaneous Use Determination

Sub-task 6.1 - Microbiological Study Management

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Management and coordination of microbiological study; report																					
review during 1979																					
Manhours per year:																					
1976			14															4			
1977			36					12										12			
1978			36					12										12			
1979			36					12										12			
*Field work will be complete by June 1, 1979, but report																					
coordination and review will continue through August 1, 1979																					
TOTALS																					

MANHOUR SUMMARY November 1, 1976 - August 1, 1979*
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Miscellaneous Use Determination

Sub-task 6.2 - Virus Study - Management

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Management and coordination of virus study; report review during 1979																					
Manhours per year:																					
1976			4															2			
1977			24					12										12			
1978			24					12										12			
1979			24					12										12			
*Field work will be complete by June 1, 1979, but report coordination and review will continue through August 1, 1979																					
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 Solids Storage Basins EIR Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1977																					
A - Project Management	21		11	14		87	14													34	
B - Background Information	8		8	4		56	76							20						48	
C - Engineering Services	4		24	20		104	124							16						40	
D - Preliminary Evaluation	12		20	8		88	76							24						40	
E - Odor Evaluation			16	8		72	104							24						32	
F - Water Quality Evaluation	4		8	8		76	104							16						32	
G - Soils Evaluation	4		4	8		32	32							24						16	
H - Environmental Assessment	8		24	16		136	152							24						56	
I - Recommended Program	20		30	12		96	104							16						28	
J - Preliminary Draft			8	4		40	72							64						136	
K - Draft EIR Production	8		8	8		60	64							40						216	
(1977) Subtotal	89		161	110		847	922							268						678	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 Solids Storage Basins EIR Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1978																					
A - Project Management	15		9	10		65	10													26	
L - Draft EIR Review	24		24			48															
M - Preliminary Final EIR	8		8	4		88	96							16						96	
N - Final EIR	4		4	4		24	40							16						72	
(1978) Subtotals	51		45	18		225	146							32						194	
(1977 + 1978) TOTALS	140		206	128		1072	1068							300						872	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task A - Project Management

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
A. Project Management:																					
1. Develop work plan and staff assignments	8		4	8		24														8	
2. Progress reporting	16		8	8		48														20	
3. Coordinate with SSB studies	12		8			24														16	
4. EIR team management				8		56	24													16	
8 months (1977) Subtotal	21		11	14		87	14													34	
6 months (1978) Subtotal	15		9	10		65	10													26	
(1977 + 1978) TOTALS	36		20	24		152	24													60	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task B - Background Information

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
B. Background Information																					
1. Develop on-site and regional environ. data						8	16							8						16	
2. Develop site data						16	28							8						16	
3. Wastewater solids background						8	16							4						8	
4. Legislative, regulatory, jurisdictional and planning requirements background	8		8	4		24	16													8	
(1977) TOTALS	8		8	4		56	76							20						40	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task C - Engineering Services

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
C. Engineering Services:																					
1. Develop solids flow sheets			4			16	24							8						8	
2. Update capital and O&M costs			4	4		24	32													8	
3. Develop implementation schedule	4		4	4		16	12														
4. Determine energy usage			4	4		16	16													8	
5. Operations data and employment			4	4		16	24													8	
6. Determine land requirements and location			4	4		16	16							8						8	
(1977) TOTALS	4		24	20		104	124							16						40	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task D - Preliminary Evaluation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
D. Preliminary Evaluation:																					
1. Develop current context of solids planning	4		4			16	24							8						8	
2. Develop array of alternatives	4		8	4		24	12							8						16	
3. Evaluate feasibility and effectiveness			4	4		32	24													8	
4. Describe viable alternatives	4		4			16	16							8						8	
(1977) TOTALS	12		20	8		88	76							24						40	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR
Soils and
Sub-tasks E and F - Water Quality Evaluations

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
E. Soils Evaluation:																					
1. Depict soil types in potential use areas				4		12	16							16						4	
2. Evaluate effect of long-term application	4		4	4		20	16							8						12	
(1977) Subtotal	4		4	8		32	32							24						16	
F. Water Quality Evaluation:																					
1. Interface with sub-tasks 4.3 and 5.3			4			20	16														
2. Depict date already gathered other subtasks				4		16	28							8						12	
3. Collect data from other studies						16	28													4	
4. Preliminary alternative evaluation	4		4	4		24	32							8						16	
(1978) Subtotal	4		8	8		76	104							16						32	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task G - Odor Evaluation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
G. Odor Evaluation																					
1. Interface with sub-tasks 4.4, 4.5, 4.6			8			24	32													8	
2. Depict data generated in other sub-tasks			4	4		16	32							8						8	
3. Evaluate other alter-natives for odor																					
potential through literature and related			4	4		32	40							16						16	
studies																					
(1977) TOTALS			16	8		72	104							24						32	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task H - Environmental Assessment

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
H. Environmental Assessment:																					
1. Economic evaluation			4			24	28													8	
2. Land utilization analysis			4	4		16	24							16						8	
3. Energy needs			4			24	28													4	
4. Transportation effects for landfill			4	4		16	24							8						8	
5. Resource conservation						20	12													4	
6. Institutional/ political constraints	4		4	4		16	8													4	
7. Public acceptability	4		4			8	4													4	
8. Summarize sub-tasks E, F, G			4	4		12	24													16	
(1977) TOTALS	8		24	16		136	152							24						56	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task I - Recommended Program

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
I. Recommended Program:																					
1. Review of alternative assessment - changes	8		12	4		32	16							8						12	
and modifications																					
2. Develop recommended program and evaluate	8		12	4		40	56							8						16	
specific implementatio																					
3. Develop and evaluate potential mitigation	4		8	4		24	32														
measures																					
(1977) TOTALS	20		30	12		96	104							16						28	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR
Sub-tasks J & K - Preliminary Draft and Draft EIR Production

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
J. Preliminary Draft EIR:																					
1. Update from SSB studies			4			16	32							8						16	
2. Production & editing			4	4		24	40							56						120	
(1977) Subtotal			8	4		40	72							64						136	
K. Draft EIR Production:																					
1. Review meetings and conversations	4		4			16	8														
2. Changes & modifications	4		4	4		24	32							16						32	
3. Final editing, drafting and typing				4		8	16							24						160	
4. Supervise printing						8	16													8	
5. Draft EIR distribution						4	8													16	
(1977) Subtotal	8		8	8		60	64							40						216	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR
Draft EIR Review and
Sub-tasks L and M - Preliminary Final EIR

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
L. Draft EIR Review																					
1. Hearings preparation and attendance	16		16			32															
2. Meetings with regulatory & planning agencies	8		8			16															
(1978) Subtotals	24		24			48															
M. Preliminary Final EIR																					
1. Summarize comments						8	16													8	
2. Prepare response to comments	8		8			64	56													24	
3. Develop supplemental report				4		16	24							16						64	
(1978) Subtotals	8		8	4		88	96							16						96	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.1 SSB EIR

Sub-task N - Final EIR

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
N. Final EIR																					
1. Review of preliminary final EIR and preparations for printing	4		4	4		24	32							16						56	
2. Supervise printing							4													8	
3. Distribute final EIR							4													8	
(1978) TOTALS	4		4	4		24	40							16						72	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 Dedicated Land Disposal EIR Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1979																					
A - Project Management	8		8	8		48	4													16	
B - Background Information	8		8	4		52	64							20						40	
C - Engineering Services	8		20	16		52	60							16						28	
D - Preliminary Evaluation	12		16	8		48	56							24						40	
E - Soils Evaluation	4		12	12		64	96							24						32	
F - Water Quality Evaluation	12		24	12		100	120							12						44	
G - Odor Evaluation			4			16	16							4						8	
H - Environemtnal Assessment	8		24	20		108	112							20						56	
I - Recommended Program	16		24	8		56	40							16						28	
J - Preliminary Draft EIR			4	4		24	40							56						96	
K - Draft EIR Production	8		8	8		60	60							32						176	
(1979) Subtotal	84		152	100		628	668							224						564	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 Dedicated Land Disposal EIR Summary

(continued)

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1980																					
A - Project Management	4		8	4		32	4													12	
L - Draft EIR Review	24		24			48															
M - Preliminary Final EIR	8		8	4		88	96							16						96	
N - Final EIR	4		4	4		24	40							16						72	
(1980) Subtotal	40		44	12		192	140							32						180	
(1979 + 1980) TOTALS	124		196	112		820	808							256						744	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task A - Program Management

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
A. Project Management																					
1. Develop work plan and staff assignments	4		4	4		16														8	
2. Progress reporting	8		12	4		32														12	
3. EIR team management				4		32	8													8	
1979 Subtotal	8		8	8		48	4													16	
1980 Subtotal	4		8	4		32	4													12	
(1979+1980) TOTALS	12		16	12		80	8													28	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task B - Background Information

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
B. Background Information																					
1. Develop on-site and regional environmental data						8	8							8						8	
2. Develop site data						16	32							8						16	
3. Wastewater solids background						4	8							4						8	
4. Legislative, regulatory, jurisdictional, and planning requirements	8		8	4		24	16													8	
(1979) TOTALS	8		8	4		52	64							20						40	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task C - Engineering Services

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
C. Engineering Services																					
1. Update solids flow sheets			4			12	16							8						8	
2. Update capital and O&M costs			4	4		8	16													8	
3. Update inplementation schedules	4		4	4		8	8														
4. Determine energy usage						4	4														
5. Update operations data			4			8	8													4	
6. Determine land requirements and location	4		4	4		12	8							8						8	
(1979) TOTALS	8		20	16		52	60							16						28	

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MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DI.D EIR

Sub-task D - Preliminary Evaluation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
D. Preliminary Evaluation																					
1. Develop current context of solids planning	4		4			8	16							8						8	
2. Develop array of alternatives	4		4	4		8	8							8						16	
3. Evaluate feasibility and effectiveness			4	4		24	16													8	
4. Describe viable alternatives	4		4			8	16							8						8	
(1979) TOTALS	12		16	8		48	56							24						40	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task E - Soils Evaluation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
E. Soils Evaluation																					
1. Depict soil types in potential use areas						8	8							16						4	
2. Collect and analyze data from Subtask 5.2			4	4		16	28													8	
3. Evaluate application rates for agricultural spending			4	4		16	24													8	
4. Evaluate trenching						12	20													8	
5. Compare alternatives for soils and land impacts	4		4	4		12	16							8						4	
(1979) TOTALS	4		12	12		64	96							24						32	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task F - Water Quality Evaluation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
F. Water Quality Evaluation																					
1. Collect data gathered on subtasks 4.3, 5.3			4			16	28													8	
2. Analyze and evaluate DLD effects on groundwater	4		8	4		24	32							4						8	
3. Analyze and evaluate agricultural land disposal effects	4		4	4		24	24							4						8	
4. Analyze and evaluate landfill effects						16	12													4	
5. Compare groundwater and surface water effects from all options	4		8	4		20	24							8						16	
(1979) TOTALS	12		24	12		100	120							12						44	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task G - Odor Evaluation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
G. Odor Evaluation																					
1. Update odor evaluation from SSB EIR			4			16	16							4						8	
(1979) TOTALS			4			16	16							4						8	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task H - Environmental Assessment

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
H. Environmental Assessment																					
1. Update economic evaluation						8	8													4	
2. Update land utilization			4	4		16	20							8						8	
3. Update energy needs						8	8													4	
4. Transportation effects			4	4		16	12							8						8	
5. Resource conservation						4	8													4	
6. Institutional/political constraints	4		4			8														4	
7. Public acceptability	4		4	4		16	24													8	
8. Public health			4	4		24	16							4						8	
9. Summarize subtasks E, F, G			4	4		8	16													8	
(1979) TOTALS	8		24	20		108	112							20						56	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task I - Recommended Program

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
I. Recommended Program																					
1. Review of alternative assessment - changes and modifications	8		12	4		32	16							8						12	
2. Develop recommended program and evaluate specific interpretation	8		12	4		24	24							8						16	
(1979) TOTALS	16		24	8		56	40							16						28	

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR
Preliminary Draft EIR and
Sub-tasks J & K - Draft EIR Production

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
J. Preliminary Draft EIR																					
1. Production & Editing			4	4		24	40							56						96	
(1979) Subtotal			4	4		24	40							56						96	
K. Draft EIR Production																					
1. Review meetings and conversations	4		4			16	8														
2. Changes & modifications	4		4	4		24	32							16						32	
3. Final editing, drafting and typing				4		8	16							16						120	
4. Supervise printing						8														8	
5. Draft EIR distribution						4	4													16	
(1979) Subtotal	8		8	8		60	60							32						176	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR
Draft EIR Review and
Sub-tasks L & M - Preliminary Final EIR

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
L. Draft EIR Review																					
1. Hearings preparation and attendance	16		16			32															
2. Meetings with regulatory and planning agencies	8		8			16															
(1980) Subtotal	24		24			48															
M. Preliminary Final EIR																					
1. Summarize comments						8	16													8	
2. Prepare responses to comments	8		8			64	56													24	
3. Develop supplemental report				4		16	24							16						64	
(1980) Subtotal	8		8	4		88	96							16						96	
TOTALS																					

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM EIRs (J232)

TASK 7.2 DLD EIR

Sub-task N - Final EIR

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
N. Final EIR																					
1. Review of preliminary final EIR and preparation for printing	4		4	4		24	32							16						56	
2. Supervise printing							4													8	
3. Distribution final EIR							4													8	
(1980) TOTALS	4		4	4		24	40							16						72	

ATTACHMENT B

TRAVEL COSTS

Subtask	Year	Miles	Cost Per Mile ($)	Cost ($)
1.2	1976	800	.15	120
	1977	4,800	.17	816
	1978	4,800	.19	912
	1979	2,400	.21	504
1.2 Subtotal				2,352
2.1	1979	1,000	.21	210
3.1	1977	1,800	.17	306
4.1	1976	200	.15	30*
	1977	3,200	.17	544
4.1 Subtotal				574
4.2	1977	1,200	.17	204
4.5	1976	1,750	.15	262.50
	1977	5,250	.17	892.50
4.5 Subtotal				1,155.00
4.6	1976	600	.15	90*
4.8	1976	400	.15	60
	1977	2,000	.17	340
4.8 Subtotal				400
5.1	1976	1,000	.15	150
	1977	6,000	.17	1,020
	1978	6,000	.19	1,140
	1979	3,000	.21	630
5.1 Subtotal				2,940

ATTACHMENT B
(continued)

TRAVEL COSTS

Subtask	Year	Miles	Cost Per Mile ($)	Cost ($)
5.3	1976	180	.15	27
	1977	1,080	.17	183.60
	1978	1,080	.19	205.20
	1979	540	.21	113.40
5.3 Subtotal				529.20
7.1	1977	800	.17	136
	1978	600	.19	114
7.1 Subtotal				250
7.2	1979	600	.21	126
	1980	600	.23	138
7.2 Subtotal				264
TOTAL				9,274.20

*Costs incurred prior to November 1, 1976 but not billed to District in invoices covering the period through October 1976.

ATTACHMENT C

I. Toll Calls

Subtask		Cost ($)
1.1	-	50
1.2	$50/month for 35 months	1,750
4.8	$25/month for 14 months	350
TOTAL		2,150

II. Expendable Supplies

Subtask	Item	Cost ($)
1.1	Miscellaneous supplies	50
1.2	$50/month for 35 months for miscellaneous supplies	1,750
2.1	Special signs	290
4.8	$75/month for 14 months	1,050
TOTAL		3,140

III. Copying and Printing

Subtask	Item	Cost ($)
1.1	Miscellaneous copies	100
1.2	Miscellaneous copies, $50/month for 35 months	1,750
1.3	SSMP final report printing	6,700
3.3	Progress report printing	1,000
4.2	Report printing	1,000
4.5	Miscellaneous copies	200*
	Report printing	1,000
4.5 Subtotal		1,200
4.6	Report printing	1,000
4.8	SSB report printing	4,000
5.1	DLD report printing	3,000
7.1	Miscellaneous copies	680
	Preliminary draft EIR	1,700
	Draft EIR	9,000
	Final EIR (supplement)	2,000
7.1 Subtotal		13,380

ATTACHMENT C
(continued)

III. Copying and Printing (continued)

Subtask	Item	Cost ($)
7.2	Miscellaneous copies	640
	Preliminary draft EIR	1,600
	Draft EIR	8,000
	Final EIR (supplement)	2,300
7.2 Subtotal		12,540
TOTAL		45,670

IV. Equipment and Miscellaneous Costs

Subtask	Item	Cost ($)
1.2	Miscellaneous costs	679.45
3.1	Sample cold storage	1,000.00
4.1	Miscellaneous costs	38.80*
4.2	Utilities for 2-1/2 months at $45/month	112.50
4.5	Mixers and rotostrainer costs	349.11*
	Mixers and related equipment	2,745.02*
	Source control facility construction	9,673.72*
	Utilities for 2 months at $47.50/month	85.00*
	Mixers and rotostrainer installation	2,894.00
	Rotostrainer rental	3,500.00
	Utilities for 4-1/2 months at $47.50/month	202.50
4.5 Subtotal		19,449.35
4.6	Meteorological equipment and modifications	1,052.99*
5.1	Miscellaneous costs	103.70*
5.2	Construction and repair	4,708.40*
5.3	Miscellaneous costs	46.05*
TOTAL		27,191.33

ATTACHMENT C
(continued)

V. Laboratory Tests

Task	Year	Sample Source	Type of Tests	No.	Rate ($)	Cost ($)
3.1	1977	Sludge	heavy metals	50	77.00	3,850
	1977	"	pesticides	50	70.00	3,500
	1977	"	freeze drying	350	4.29	1,500
3.1 Subtotal						8,850
3.2	1977	influent/effluent	heavy metals	20	77.00	1,540
	1977	"	pesticides	20	70.00	1,400
	1977	"	freeze drying	140	5.71	800
3.2 Subtotal						3,740
4.1	1976	Miscellaneous analysis prior to 11/1/76				6,135*
	1976	SSB surface	EC, turbidity, algae	16	22.50	360
	1977	"	"	224	22.50	5,040
	1977	digested sludge	nutrients	4	55.00	220
	1977	SSB inventory	solids	32	150.00	480
	1977	"	heavy metals & pesticides	32	275.00	8,800
4.1 Subtotal						21,035
4.3	1976	miscellaneous analysis prior to 11/1/76				1,340*
	1976	groundwater	partial mineral, nitrogen	16	72.50	1,160
	1977	"	"	80	72.50	5,800
	1977	"	complete analysis	16	115.00	1,840
4.3 Subtotal						10,140
4.5	1976	SSBs	EC, turbidity, algae	14	22.50	315
	1977	"	"	38	22.50	855
4.5 Subtotal						1,170

ATTACHMENT C
(continued)

V. Laboratory Tests (continued)

Task	Year	Sample Source	Type of Tests	No.	Rate ($)	Cost ($)
5.3	1976	Miscellaneous analysis prior to 11/1/76				5,154*
	1976	creekwater	metals, nutrients, bacteria, & pesticides	10	292	2 920
	1977	"	"	60	292	17,520
	1978	"	"	60	321	19,260
	1979	"	"	25	353	8,825
	1977	harvested sludge	metals, nutrients, pesticides	12	250	3,000
	1978	"	"	12	275	3,300
	1976	soils	Cd, Cu, Ni, Zn (DPTA)	24	49.50	1,188
	1977	"	"	24	49.50	1,188
	1978	"	"	24	54.50	1,308
	1979	"	"	12	60.00	720
	1976	soils	pesticide residues	24	70.00	1,680
	1977	"	"	24	70.00	1,680
	1978	"	"	24	77.00	1,848
	1979	"	"	12	85.00	1,020
	1976	soils	CEC, TKN, NH_4, TOC	24	68.50	1,644
	1977	"	"	24	68.50	1,644
	1978	"	"	24	75.00	1,800
	1979	"	"	12	82.50	990
	1976	soils solutions	pesticide residues	6	70.00	420
	1977	"	"	12	70.00	842
	1978	"	"	12	77.00	924
	1979	"	"	6	85.00	510
	1976	soil solutions	Zn, Cd	6	25.50	153
	1977	"	"	12	25.50	306
	1978	"	"	12	28.00	336
	1979	"	"	6	31.00	186

ATTACHMENT C
(continued)

V. Laboratory Tests (continued)

Task	Year	Sample Source	Type of Tests	No.	Rate ($)	Cost ($)
5.3	1976	groundwater	Zn, Cd	12	25.50	306
	1977	"	"	24	25.50	712
	1978	"	"	24	28.00	672
	1979	"	"	12	31.00	744
	1976	groundwater	Pesticide residues	3	70.00	210
	1977	"	"	6	70.00	420
	1978	"	"	6	77.00	462
	1979	"	"	3	85.00	255
	1976	runoff water	Cl, Cu, Ni, Zn, Pb, Hg	6	84.50	507
	1977	"	"	12	84.50	1,014
	1978	"	"	12	93.00	1,116
	1979	"	"	6	102.00	612
	1976	runoff water	TKN, NH_4	6	26.50	159
	1977	"	"	12	26.50	318
	1978	"	"	12	29.00	348
	1979	"	"	6	32.00	192
	1976	runoff water	T. Coli, F. Strep, F. Coli	6	38.00	228
	1977	"	"	12	38.00	456
	1978	"	"	12	42.00	504
	1979	"	"	6	46.00	276
	1976	runoff water	Pesticides	6	70.00	420
	1977	"	"	12	70.00	840
	1978	"	"	12	77.00	924
	1979	"	"	6	85.00	510
5.3 Subtotal						92,571
TOTAL						137,506

*Costs incurred prior to November 1, 1976 but not billed to District in invoices covering the period through October 1976.

ATTACHMENT C SUMMARY

	Item	Cost ($)
I.	Toll Calls	2,150.00
II.	Expendable Supplies	3,140.00
III.	Copying and Printing	45,670.00
IV.	Equipment and Miscellaneous Costs	27,191.33
V.	Laboratory Tests	137,506.00
	TOTAL	215,657.00

ATTACHMENT D

SUBCONTRACTS

Task		Cost ($)
4.2	Student for 618 hours at $6/hour	3,708
4.2	Student for 618 hours at $6/hour	3,708
4.2	Student for 618 hours at $6/hours	3,708
4.2 Subtotal		11,124
4.3	Soils subcontractor	8,000
7.1	Archaeology subcontractor	400
TOTAL		19,524

SECTION 5

DWIGHT C. BAIER PROPOSAL

Dwight C. Baier, Agricultural Consultant

1423 McKINLEY AVENUE
WOODLAND, CALIFORNIA 95695
(916) 662-6516

November 23, 1976

Sacramento Area Consultants
1101 R Street
Sacramento, California 95814

RE: Job J222A

Attached herewith is a proposed budget for portions of Tasks 5.1, 5.2, 5.3 and 4.3 SSB Groundwater of the Wastewater Solids Management Program from the February 1976 SSMP workplan. This proposal is for a per diem contract in the amount of $350,794.62.

Respectfully,

Dwight C. Baier

DCB:bb

Enclosures

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS *(See accompanying instructions before completing this form)*	*Form Approved* *OMB No. 158-R0144*

PART I - GENERAL

1. GRANTEE

2. GRANT NUMBER

3. NAME OF CONTRACTOR OR SUBCONTRACTOR: Dwight C. Baier, Agricultural Consultant

4. DATE OF PROPOSAL

5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)*

1423 McKinley Ave.
Woodland, CA 95695

6. TYPE OF SERVICE TO BE FURNISHED: Dedicated Land Disposal

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Attachment C		$	$ 105979.10	
DIRECT LABOR TOTAL:				$ 105979.10

8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	TOTALS
Salary Overhead, %	24	$ 105979.10	$ 25434.98	
General Administrative Overhead, %	59	105979.10	62527.67	
INDIRECT COSTS TOTAL:				$ 87962.65

9. OTHER DIRECT COSTS

a. TRAVEL			ESTIMATED COST	TOTALS
(1) TRANSPORTATION Attachment D			$ 10543.75	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$	

b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	TOTALS
5.1 Attachment E		$	$ 4308.00	
5.2 Attachment E			86632.00	
5.3 Attachment E			9232.00	
EQUIPMENT SUBTOTAL:			100172.00	

c. SUBCONTRACTS			ESTIMATED COST	TOTALS
Attachment G			$ 3250.00	
SUBCONTRACTS SUBTOTAL:			$ 3250.00	

d. OTHER *(Specify categories)*			ESTIMATED COST	TOTALS
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 113,965.75

10. TOTAL ESTIMATED COST	$ 307,907.50
11. PROFIT	$ 42,887.12
12. TOTAL PRICE	$ 350,794.62

Form Approved
OMB No. 158-R0144

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES (Indicate basis for price comparison)	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If "Yes" give name address and telephone number of reviewing office)*

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

SEE ATTACHMENT A.

14c.

This proposal is submitted for use in connection with and in response to (1) SAE REQUEST . This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of (2) 12-8-76 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) 12-8-76
DATE OF EXECUTION

Virgles O'Brien
SIGNATURE OF PROPOSER

Owner.
TITLE OF PROPOSER

15. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

Dwight C. Baier, Agricultural Consultant
1423 McKINLEY AVENUE
WOODLAND, CALIFORNIA 95695
[916] 662-6516

ATTACHMENT A

SCHEDULE OF HOURLY RATES

Grade Code		Grade	Labor cost (1.83)	Profit (18%)	Billing[a] Rate
	Professional Staff				
14	Agricultural Consultant	-	$29.57	$5.32	$34.89
13	Assistant Ag Consultant	-	15.87	2.86	18.72
21	Agricultural Specialist	I	10.98	1.98	12.96
22	Agricultural Specialist	II	11.90	2.14	14.04
23	Agricultural Specialist	III	12.81	2.31	15.12
24	Agricultural Specialist	IV	13.73	2.47	16.20
	Technical Staff				
31	Field Assistant	I	7.32	1.32	8.64
32	Field Assistant	II	8.23	1.48	9.71
33	Field Assistant	III	9.15	1.65	10.80
34	Field Assistant	IV	10.06	1.81	11.87
35	Field Assistant	V	10.98	1.98	12.96
	Administrative Staff				
41	Office Supervisor	-	8.46	1.52	9.99
51	Typist	I	5.83	1.05	6.88
52	Typist	II	7.10	1.28	8.38
53	Typist	III	8.67	1.56	10.23
54	Typist	IV	10.49	1.89	12.37

---

[a] Effective November 1, 1976

11/19/76

SAC J 222A

ATTACHMENT A (Continued)

Dwight C. Baier

The rates proposed herein are effective November 1, 1976 and will continue through the end of 1977*. Indirect costs are those which are identifiable as specific client-project costs. Indirect costs are separated into two pools: salary overheads, that is, fringe benefit costs and general administrative overheads, and all other indirect costs. These indirect cost pools, as noted above, are computed and expressed as a percent of direct labor costs.

Profit is computed as 18% of labor cost plus overhead and 7% of all other direct costs.

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*Rates for future years include 10% per year escalation.

ATTACHMENT B

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT

PERCENTAGES

Salary Overheads	Total as % of Direct Labor	Unallowable Costs as a % of Direct Labor	Allowable Costs as a % of Direct Labor
Payroll Taxes	8.0 %	-	8.0%
Paid Leaves	10.0	-	10.0
Group Insurance & Health Care	5.5	-	5.5
Total Salary Overheads	23.5		23.5
General & Administrative Overheads			
Indirect Salaries	11.0	-	11.0
Rent, Buildings	1.9	-	1.9
Rent, Equipment	1.2	-	1.2
Secretarial	8.5	-	8.5
Office Expenses	9.6	-	9.6
Postage, Telephone	.8	-	.8
Insurance	9.6	-	9.6
Automobile Expenses*	9.9	-	9.9
Travel & Subsistence*	5.8	-	5.8
Legal & Accounting	.7	-	.7
Professional Education	.5	-	.5
Interest on Borrowings	5.70	5.70	-
Promotion & Entertainment	.74	.74	-
	65.94	6.44	59.5

* Excluding those expenses billed as direct costs.

2/7/76

ATTACHMENT C

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT
MANHOUR SUMMARY
1976

TASK*	TASK DESCRIPTION	14	13	21	22	23	24	31	32	33	34	35	41	52
5.1	Planning & Supervision	200				50							120	
5.2	Site Preparation Spreading	10				40					80		20	
5.3	Soils													
	Laboratory preparation					40					80			
	Field Collection	4				20					20			
	Grinding, preparation	15				20								
	Extraction	10				24								
	Analysis	20				50								
	Soil Solutons													
	collection	30				100								
	analysis	20				100								
	Groundwater													
	collection					50								
	analysis	2				18								
	Runoff water													
	collection					50								
	analysis	2				9								
	TOTAL	313				571					180		140	

*Task numbering based on February 1976 SSMP Workplan.

12/7/76

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT

MANHOUR SUMMARY

1977

TASK*	TASK DESCRIPTION	GRADE CODE 14	13	21	22	23	24	31	32	33	34	35	41	52
5.1	Planning & Supervision	400				100							360	
5.2	Site Preparation	16				80					80		40	
	Spreading	576				400					2000			
5.3	Soils													
	Field Collection	8				40					40			
	Grinding, Preparation	30				40								
	Extracting	20				48								
	Analysis	40				100							40	
	Soil Solutions													
	Collection	60				200								
	Analysis	40				200							40	
	Groundwater													
	Collection					100								
	Analysis	4				36							40	
	Runoff Water													
	Collection													
	Analysis	4				100							40	
4.3	SSB Groundwater	60									50			
	TOTAL	1258				1462					2170		560	

*Task numbering based on February 1976 SSMF Workplan.

12/7/76

SAC 222A

ATTACHMEN C_2

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT
MANHOUR SUMMARY
1978

TASK*	TASK DESCRIPTION	GRADE CODE													
		14	13	21	22	23	24	31	32	33	34	35	41	52	55
5.1	Planning & Supervision	400				100							360		
5.2	Site Preparation														
	Spreading	288				200					1000		40		
5.3	Soils														
	Field Collection	8				40					40				
	Grinding, Preparation	30				40									
	Extracting	20				48									
	Analysis	40				100							40		
	Soil Solutions														
	Collection	60				200									
	Analysis	40				200							40		
	Groundwater														
	Collection					100									
	Analysis	4				36							40		
	Runoff Water														
	Collection					100									
	Analysis	4				18							40		
	TOTAL	894				1182					1040		560		

* Task numbering based on February 1976 SSMP Workplan.

11/23/76 ATTACHMENT C_3 SAC J222A

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT

MANHOUR SUMMARY

1979

TASK*	TASK DESCRIPTION	GRADE CODE												
		14	13	21	22	23	24	31	32	33	34	35	41	52
5.1	Planning & Supervision	200				50							180	
	Final Report	250											240	
5.3	Soils													
	Field Collection	4				20					20			
	Grinding, Preparation	15				20								
	Extracting	10				24								
	Analysis	20				50							20	
	Soil Solutions													
	Collection	30				100								
	Analysis	20				100							20	
	Groundwater													
	Collection	2				9								
	Analysis					50							20	
	Runoff Water													
	Collection					50								
	Analysis	2				9							20	
	TOTAL	553				482					20		500	

*Task numbering based on February 1976 SSMP Workplan.

12/7/76 ATTACHMENT C_4 SAC J222A

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT

SUMMARY OF DIRECT LABOR COSTS

1976				1977				1978				1979			
GRADE	MAN HOURS	DIRECT LABOR RATE	COST	GRADE	MAN HOURS	DIRECT LABOR RATE	COST	GRADE	MAN Hours	DIRECT LABOR RATE	COST	GRADE	MAN HOURS	DIRECT RATE	LABOR COST
14	313	$16.16	$5058.08	14	1258	$16.16	$20329.28	14	894	$17.78	$15895.32	14	553	$19.56	$10816.68
23	571	7.00	3997.00	23	1462	7.00	10234.00	23	1182	7.70	9101.40	23	482	8.47	4082.54
34	180	5.00	900.00	34	2170	5.00	10850.00	34	1040	5.50	5720.00	34	20	6.05	121
41	140	4.62	646.80	41	560	4.62	2587.20	41	560	5.08	2844.80	41	500	5.59	2795.00
TOTAL COST			10601.88				$44000.48				$33561.52				17815.22

ATTACHMENT D

TRANSPORTATION AND TRAVEL EXPENSES

DWIGHT C. BAIER

TASK 5.1	Year	Miles	Rate/Mile	Amount	
5.1	1976	400	.25	$100.00	
	1977	2400	.25	$600.00	
	1978	2400	.275	660.00	
	1979	2400	.30	720.00	
		Total			$2080.00
5.2					
5.2	1976	400	.25	100.00	
	1977	8400	.25	2100	
	1978	8400	.275	2310	
		Total			4510.00
5.3					
5.3	1976	800	.25	200.00	
	1977	4550	.25	1137.50	
	1978	4550	.275	1251.25	
	1979	4550	.30	1365.00	
		Total			3953.75
	TOTAL TRAVEL				$10543.75

11/23/76 ATTACHMENT E [illegible]

DWIGHT C. PAIER, AGRICULTURAL CONSULTANT
EQUIPMENT, SUPPLIES, ETC.

Task #	Year	Item	Amount
5.1	1976	Expendible supplies	$ 10.00
5.1	1976	Toll calls	22.00
5.1	1977	Toll calls	$ 400.00
5.1	1977	Expendable supplies	100.00
5.1	1978	Toll calls	400.00
5.1	1978	Expendable supplies	200.00
5.1	1979	Typing final report	200.00
5.1	1979	Expendable supplies	600.00
5.1	1979	Reproduction costs	1976.00
5.1	1979	Toll calls	400.00
		TOTAL 5.1	$ 4308.00
5.2	1976	Pump rental	$ 200.00
5.2	1976	Miscellaneous	232.00
5.2	1976	Gravel	500.00
5.2	1976	Fence	2000.00
5.2	1977	Hardware for spreading	$ 1000.00
		Fuel, grease, gas, repairs	2000.00
		Special clothing	300.00
		Instruments, special tools	400.00
		Communications equipment	300.00
		Pipeline	5200.00
5.2	1978	Repairs for power pac, radio	300.00
		New special clothing	200.00
		Fuel, grease, gasoline, repairs	1000.00
		Hardware & supplies	500.00
		Tools, instruments (replacement)	500.00
		(Subtotal 5.2)	$11700.00
5.2	1977	2 tractors and spreading equipment	$42000.00
	1978	1 tractor and spreading equipment	$30,000.00
		TOTAL 5.2	$86,632.00
5.3	1976	Laboratory equipment	
		Solubridge	450.00
		pH meter	450.00
		Hot plate	600.00
		Chemicals, supplies	400.00
		Miscellaneous (floor covering,etc)	100.00
			$2000.00
	1976	Equipment rental	300.00
	1977	Equipment rental	
		Spectrophotomoter	480.00
		Flame photometer	800.00
		Turbidity meter	240.00
			$1520.00
	1978	Equipment rental	
		Spectrophotometer	528.00
		Flame photometer	880.00
		Turbidity meter	266.00
			$1674.00
	1978	Laboratory equipment	
		Glassware, hardware	300.00
		Chemicals, supplies	400.00
		Equipment repairs	300.00
	1979	Equipment rental	
		Spectraphotometer	580.00
		Flame Photometer	968.00
		Turbidity meter	290.00
		Laboratory equipment	
		Glassware, hardware, tools	200.00
		Chemicals, supplies	400.00
		Equipment repairs	300.00
		TOTAL 5.3	[illegible]

ATTACHMENT F_1
SAMPLES TO BE COLLECTED EACH YEAR

SAMPLE TYPE	1976	1977	1978	1979	Total[1]
soils	60[3]	60[3]	60[3]	48	228
soil solutions	64[2]	128	128	64	384
groundwater	12	24	24	12	72
runoff water	6	12	12	6	36

[1] Samples and analysis have been estimated for the life of the project. Natural variances with yearly cycles should be anticipated.

[2] As of 12/1/76, 1976 rainfall far below normal. Soil solution samples cut back to reflect the lack of soil moisture.

[3] Includes 12 post-application, pre-rain soil samples.

12/7/76

SAC J222A

ATTACHMENT G

DWIGHT C. BAIER, AGRICULTURAL CONSULTANT

OTHER SUBCONTRACT SERVICES

Task	Subtask	Year	Service	Amount
5.2	Site Prep.	1977	Land Planing	$2000.00
5.3	Groundwater	1976	Drill monitoring well and run permeability tests	$1250.00
	TOTAL OTHER SUBCONTRACT SERVICES			$3250.00

SECTION 6

SPRAY WASTE, INC. PROPOSAL

SPRAY
WASTE
INC.
EFFLUENT DISPOSAL TECHNOLOGY

RECEIVED
DEC 8 1976
Sacramento Area Consultants

December 6, 1976

Sacramento Area Consultants
1101 R Street
Sacramento, California 95814

Attention: Mr. John Salo

Subject: Subagreements for Tasks 6.1 and 6.2

Gentlemen:

Transmitting herewith executed subagreements and supporting fiscal data for Tasks 6.1 and 6.2 of the Regional Sewage Solids Management Program for Sacramento County.

The agreements were kept discretely separate because of the unknown future status of the virus monitoring program as now constituted.

Sincerely,

David R. Storm

David R. Storm, Ph.D.

DRS:ck
Enclosures:
- (1) Task 6.1 subagreement
- (2) Task 6.2 subagreement
- (3) Attachments and Exhibits

O. Box 355 Davis, California 95616 Telephone: (916) 758-2150

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE
SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT

2. GRANT NUMBER

3. NAME OF CONTRACTOR OR SUBCONTRACTOR
SPRAY-WASTE, Inc.

4. DATE OF PROPOSAL

5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR (Include ZIP code)
623 Seventh Street
Davis, California 95616

6. TYPE OF SERVICE TO BE FURNISHED
Task 6.1 - Microbiological monitoring of sewage sludge, soils, site runoff, and Morrison Creek water (bacteria & helminth/protozoans).

PART II - COST SUMMARY

7. DIRECT LABOR (Specify labor categories)	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
See Attachment A	---	$ -----	$21,832.60	
DIRECT LABOR TOTAL:				$ 21,832.60

8. INDIRECT COSTS (Specify indirect cost pools)	RATE	× BASE =	ESTIMATED COST	TOTALS
Overhead on direct labor (holid.,sick,etc.)	.31	$ 21,832.60	$ 6,768.10	
Indirect overhead (ins.,supplies,etc.)	.93	21,832.60	20,304.30	
INDIRECT COSTS TOTAL:				$ 27,072.40

9. OTHER DIRECT COSTS

a. TRAVEL	ESTIMATED COST
(1) TRANSPORTATION (included in virus sampling cost)	$ ------
(2) PER DIEM	$
TRAVEL SUBTOTAL:	$ ------

b. EQUIPMENT, MATERIALS, SUPPLIES (Specify categories)	QTY	COST	ESTIMATED COST
See Attachment C	---	$ ----	$ 16,608.00
EQUIPMENT SUBTOTAL:			16,608.00

c. SUBCONTRACTS	ESTIMATED COST
N.A.	$ --------
SUBCONTRACTS SUBTOTAL:	$ --------

d. OTHER (Specify categories)	ESTIMATED COST
N.A.	$ --------
OTHER SUBTOTAL:	$ --------

e. OTHER DIRECT COSTS TOTAL:	$ 16,608.00
10. TOTAL ESTIMATED COST	$ 65,513.00
11. PROFIT	$ 8,166.15
12. TOTAL PRICE	$ 73,679.15

OMB No. 158-R0164

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES (Indicate basis for price comparison)	MARKET PRICE(S)	PROPOSED PRICE
N.A.		
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR N.A.

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If "Yes" give name address and telephone number of reviewing office)*

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41 CFR 1-15.4

14c.

This proposal is submitted for use in connection with and in response to *(1)* ______________________________ . This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* ______________________ and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) December 6, 1976
DATE OF EXECUTION

SIGNATURE OF PROPOSER

PRESIDENT, SPRAY-WASTE, Inc.
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

15. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

EPA Form 5700-41 (2-76)

PAGE 2 OF 3

ATTACHMENT A
Task 6.1

Bacteria and Helminth/Protozoan Subtask

Period	Item	Person-days	Grade	1976 Salary Scale	Total
11/1/76 to 12/31/76	Sampling, monthly report preparation, correlations, interpretations, progress meetings and annual report.	20 3	E-9 T-2	$106.64 29.60	$ 2,132.80 88.80
			Subtotal		$ 2,221.60
1/1/77 to 6/1/79	Sampling, monthly report preparation, correlations, interpretations, progress meetings and annual report.	120 10 80	E-9 E-5 T-2	$106.64 52.40 29.60	$12,796.80 524.00 2,368.00
			Subtotal		$15,688.80
		Plus 25% average salary increment (cost of living and merit raises 1977-1979)			3,922.20
			Total		$21,832.60

EXHIBIT A-1

	Total as % of Direct Labor	Unallowable Costs as a % of Direct Labor	Allowable Costs as a % of Direct Labor
Salary Overheads			
Payroll Taxes	8.94	---	8.94
Paid Leaves	11.54	---	11.54
Group Insurance	6.87	---	6.87
Fringe Benefits	3.31	---	3.31
Total Salary Overheads	30.66	---	30.66
General & Admin. Overheads			
Indirect Salaries	18.10	---	18.10
Rental for Bldgs/Equip	16.40	---	16.40
Licenses & Insurance	16.23	---	16.23
Property Taxes, Util., Misc.	2.51	---	2.51
Travel & Subsistence	4.00	---	4.00
Supplies (field & office)	8.01	---	8.01
Repairs & Maint.	1.26	---	1.26
Prof. Education	.82	---	.82
Postage & Phone	7.63	---	7.63
Depreciation	8.89	---	8.89
Legal & Accounting	1.34	---	1.34
Auto Expenses	8.15	---	8.15
Total General & Admin. Overheads	93.34	---	93.34

EXHIBIT A-2

Although there has been no change in the total projected charges, we would like to call attention to the change in direct and indirect overhead percentage rates (re: previous submittal of OMB Form #158-R0144). We have regrouped our costs to be in accordance with generally accepted accounting principles, applicable federal regulations (such as ASPR and PPR) and the Cost Accounting Standards Board standards. Indirect or overhead costs are those expenses which are identifiable as specific client-project direct costs. Indirect costs are separated into two pools: salary overheads, that is fringe benefit costs; and general and administrative overheads, that is all other indirect costs. These indirect costs pools as noted above, are computed and expressed as a percent of direct labor costs.

Principals' salaries are treated in the same manner as other employees' salaries. Only when a principal is direct and productively working on a specific project is his time charged to direct labor. All other time of a principal is charged to General and Administrative expense. The hourly charge rate is computed in the same manner for all employees.

EXHIBIT A-3

SPRAY-WASTE, Incorporated

FEE SCHEDULE

Grade	Hourly Rate	Hourly Rate Plus Overhead	Profit	Billing Rate
E-9	$13.33	$29.86	$4.48	$34.34
E-7	8.09	18.12	2.72	20.84
E-5	6.55	14.67	2.20	16.87
E-3	5.50	12.32	1.85	14.17
T-5	6.15	13.78	2.07	15.85
T-3	4.25	9.52	1.43	10.95
T-2	3.70	8.29	1.24	9.53
C-4	4.10	9.18	1.38	10.56
C-2	2.95	6.61	0.99	7.60

ATTACHMENT C
Task 6.1

Sampling Schedule and Analytical Cost
1976-1979

Year	Sampling Locations	Number of Samples	Unit Analytical Cost[*] (Bact. & Helm./Protozoan)	Total
1976	7	9 Bact.	$50.00	$ 450.00
		9 Helmin./ Protozoan	50.00	450.00
		2 Helmin. viability	50.00	100.00
1977	68	80 Bact.	53.00	4,240.00
		80 Helmin./ Protozoan	53.00	4,240.00
		16 Helmin. viability	53.00	848.00
1978	20	32 Bact.	$56.00	1,792.00
		32 Helmin./ Protozoan	56.00	1,792.00
		6 Helmin. viability	56.00	336.00
1979	12	18 Bact.	$59.00	1,062.00
		18 Helmin./ Protozoan	59.00	1,062.00
		4 Helmin. viability	59.00	236.00
TOTAL	105		TOTAL	$16,608.00

---

[*] Viability tests for helminths at $50 per samples. Assume 20% of samples positive and eggs can be embryonated and tested for viability.

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT	2. GRANT NUMBER
3. NAME OF CONTRACTOR OR SUBCONTRACTOR SPRAY-WASTE, Inc.	4. DATE OF PROPOSAL
5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)* 623 Seventh Street Davis, California 95616	6. TYPE OF SERVICE TO BE FURNISHED Task 6.2 - Virus Monitoring of Sewage Sludge, Site Runoff and Morrison Creek Water

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
See Attachment A	----	$ -----	$ 16,018.20	
DIRECT LABOR TOTAL:				$ 16,018.20

8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	TOTALS
Overhead on direct labor (sick, vac., etc.)	.31	$ 16,018.20	$ 4,965.64	
Indirect overhead (ins., supplies, etc.)	.93	16,018.20	14,896.93	
INDIRECT COSTS TOTAL:				$ 19,862.57

9. OTHER DIRECT COSTS

a. TRAVEL			ESTIMATED COST	TOTALS
(1) TRANSPORTATION See Attachment B			$ 760.80	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$ 760.80	

b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	TOTALS
See Attachment D	----	$ ------	$ 38,780.00	
EQUIPMENT SUBTOTAL:			38,780.00	

c. SUBCONTRACTS			ESTIMATED COST	TOTALS
Dr. Fredric Troy - consultation and data interpretation			$	
10 days @ $320.00			3,200.00	
SUBCONTRACTS SUBTOTAL:			$ 3,200.00	

d. OTHER *(Specify categories)*			ESTIMATED COST	TOTALS
			$	
N.A.				
OTHER SUBTOTAL:			$ ------	
e. OTHER DIRECT COSTS TOTAL:				$ 42,740.80

10. TOTAL ESTIMATED COST	$ 78,621.57
PROFIT	$ 7,321.12
TOTAL PRICE	$ 85,942.69

EPA Form 5700-41 (2-76)

PAGE 1 OF 3

OMB No. 158-R0144

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES (Indicate basis for price comparison)	MARKET PRICE(S)	PROPOSED PRICE
N.A.		
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR N.A.

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO (If "Yes" give name address and telephone number of reviewing office)

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41 CFR 1-14.5

14c.

This proposal is submitted for use in connection with and in response to *(1)* ______________________ . This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* ______________ and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) December 6, 1976
DATE OF EXECUTION

SIGNATURE OF PROPOSER

PRESIDENT, SPRAY-WASTE, Inc.
TITLE OF PROPOSER

15. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

ATTACHMENT A
Task 6.2

Virus Monitoring Subtask

Period	Item	Person-days	Grade	1976 Salary Scale	Total
11/1/76 to 12/31/76	Sampling monthly report preparation, correlations, interpretations, progress meetings and annual report.	10 2	E-9 T-2	$106.64 29.60	$ 1,066.40 59.20
				Subtotal	$ 1,125.60
1/1/77 to 6/1/79	Sampling, monthly report preparation, correlations, interpretations, progress meetings and annual report.	72 30 90	E-9 E-5 T-2	$106.64 52.40 29.60	$ 7,678.08 1,572.00 2,664.00
				Subtotal	$11,914.08
		Plus 25% average salary increment (cost of living and merit raises 1977-1979)			2,978.52
				Total	$16,018.20

ATTACHMENT B

Transportation Cost Breakdown
Task 6.2

72 trips x 50 miles x $0.16 =		$576.00
10 Inflationary Escalation		58.00
	Subtotal	$634.00
20% contingency for unscheduled trips, progress meetings and re-samplings		$126.80
	Total	$760.80

ATTACHMENT D
Task 6.2

Sampling Schedule and Analytical Cost

Year	Sampling Locations	Number of Samples	Unit Analytical Cost (virus detect. & enum.)	Total
1976	4	5	$300	$ 1,500.00
1977	56	64	$315	20,160.00
1978	16	24	$331	7,944.00
1979	8	12	$348	4,176.00
	84	105		$33,780.00
	Balance not billed on second 2 quarters 1976 samples			5,000.00
				$38,780.00

SECTION 7

EUTEK, INC. PROPOSAL

EUTEK, INC. — 1828 TRIBUTE ROAD, SUITE H • SACRAMENTO, CA 95815 • (916) 929-2003
process
development
and
engineering

RECEIVED
DEC . 9 1976
Sacramento Area Consultants

December 9, 1976

Mr. John Salo
Sacramento Area Consultants
1101 R Street
Sacramento, CA 95814

RE: REVISED FORM 5700
ADJUSTMENT OF INDIRECT/DIRECT COST RATIO

Attached please find a revised Form 5700 and attached Exhibits as per our letter of November 29, 1976. At Lyle Hoag's request we have reviewed our indirect and direct cost accumulations with our accountant, Mr. Fred Schow of Brown and Schow. A letter from Mr. Schow has been attached.

Using an annual base for estimating indirect to direct salary ratios in place of time since incorporation (April 1), the projected indirect to direct cost ratio was reduced from 2.37 to 2.08.

Exhibit I has been attached to compare the revised "other direct costs" with those in the original budget estimates. Task 4.2 had been originally budgeted using a gross overall budget figure of $20,000 without detailed breakdown of other direct costs. Thus, the direct cost associated with this task represent a further refinement. Costs for travel and material and services related to report preparation on Task 4.5 were not broken out in the original budget estimate of this project. Task 4.5 VI providing for routine maintenance of pumps and mechanical equipment at the pilot odor stripping facility was not originally estimated as it had been assumed that County plant personnel would participate in these phases of the project. On the large scale odor study, Task 4.6, estimates for the major costs of the wind machine, simulated landscaping, and chemicals have been revised in view of more specific information on the remaining studies required to complete this project. Other direct costs were not originally estimated in Task 4.6 for report preparation but have been included in the projected budget for completion of this project.

I hope this information will be satisfactory. We will be happy to answer any questions regarding the attached material.

Very truly yours,

EUTEK, INC.
Process Development and Engineering

George E. Wilson

George E. Wilson

GEW/kmt
cc: Mr. Fred Schow

RICHARD S. BROWN, CPA
FRED F. SCHOW, CPA

BROWN & SCHOW
Certified Public Accountants
1600 Executive Court
Sacramento, California 95823

Phone 483-6646

December 9, 1976

Sacramento Area Consultants
1101 R Street
Sacramento, California 95814

Gentlemen:

As you requested, this letter is to inform you that Eutek Inc. consulted us, and we provided them with technical assistance in the preparation of present and projected indirect cost in percentages, as shown on Exhibit F.

That portion pertaining to the year November 1, 1975 to October 31, 1976 was based on their unaudited financial statements for that period. Also, that portion pertaining to the year November 1, 1976 to October 31, 1977 was based on events and transactions subsequent to date of the report. Therefore, we accept no responsibility to update or revise the report.

Because the statements were prepared by personnel of Eutek Inc. with our technical assistance, from unaudited statements and from assumptions about future events based on present circumstances and available information, we do not express an opinion on the reasonableness or comprehensiveness of those assumptions.

Projections are inherently subject to varying degrees of uncertainty, and their achievability depends on timing and probability of a complex series of future events, both internal and external, to an enterprise. Accordingly, we do not express an opinion on the achievability of the projections or on the probability that the actual results for any period may or may not approximate the projections.

Very truly yours,

Fred S. Schow

BROWN & SCHOW

RECEIVED
DEC 9 1976
Sacramento Area Consultants

FS:bmb

EXHIBIT A

FORM 5700-41

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form.)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE Sacramento Regional County Sanitation District	2. GRANT NUMBER
3. NAME OF CONTRACTOR OR SUBCONTRACTOR EUTEK, INC.	4. DATE OF PROPOSAL December 7, 1976
5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR (Include ZIP code) 1828 Tribute Rd., Suite H Sacramento, CA 95815	6. TYPE OF SERVICE TO BE FURNISHED SAC Job # J222A Odor Studies

PART II - COST SUMMARY

7. DIRECT LABOR (Specify labor categories)	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Principal Engineer	224	$ 24.20	$ 5,420.80	
Senior Engineer	912	14.03	12,795.36	
Staff Engineer	216	12.10	2,613.60	
Supervisor	776	7.70	5,975.20	
Tech./Draftsman	2160	6.82	14,731.20	
Ass't. Technician	1392	4.40	6,124.80	
Clerical	288	4.40	1,267.20	
DIRECT LABOR TOTAL:				$ 48,928.16
8. INDIRECT COSTS (Specify indirect cost pools)	RATE	× BASE =	ESTIMATED COST	
(See Exhibit F)	2.08	$ 48,928.16	$ 101,770.57	
INDIRECT COSTS TOTAL:				$ 101,770.57
9. OTHER DIRECT COSTS (See Exhibit H)				
a. TRAVEL			ESTIMATED COST	
(1) TRANSPORTATION			$ 4,525.00	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$ 4,525.00	
b. EQUIPMENT, MATERIALS, SUPPLIES (Specify categories)	QTY	COST	ESTIMATED COST	
Materials		$	$ 5,550.00	
Machine Rental			1,100.00	
Report Cost			8,900.00	
Chemicals			12,000.00	
EQUIPMENT SUBTOTAL:			27,550.00	
c. SUBCONTRACTS			ESTIMATED COST	
Outside Services			$ 4,850.00	
SUBCONTRACTS SUBTOTAL:			$ 4,850.00	
d. OTHER (Specify categories)			ESTIMATED COST	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 36,925.00
10. TOTAL ESTIMATED COST				$ 187,623.73
11. PROFIT	@18% of Direct/Indirect Cost			$ 27,125.77
12. TOTAL PRICE				$ 214,749.50

EPA Form 5700-41 (2-76)

PAGE 1 OF 5

EXHIBIT A

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES *(Indicate basis for price comparison)*	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If "Yes" give name address and telephone number of reviewing office)*

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

See Exhibit G

14c.

This proposal is submitted for use in connection with and in response to *(1)* SAC Request . This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* November 1, 1976 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) November 29, 1976
DATE OF EXECUTION

George E. Wilson
SIGNATURE OF PROPOSER

PRESIDENT
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

EPA Form 5700-41 (2-76)

PAGE 2 OF

EXHIBIT B

HOURLY RATE SCHEDULE

EXHIBIT B

HOURLY RATE SCHEDULE

CLASSIFICATION	DIRECT/INDIRECT COST CHARGE	GROSS PROFIT CHARGE (18%)	CHARGE RATE PER HOUR
Principal Engineer	$ 46.61	$ 8.39	$ 55.00
Senior Engineer	38.14	6.86	45.00
Staff Engineer	33.90	6.10	40.00
Supervisor	29.66	5.34	35.00
Technician/Draftsman	22.88	4.12	27.00
Assistant Technician	15.25	2.75	18.00
Clerical	15.25	2.75	18.00

EXHIBIT C

HOURLY RATE SCHEDULE ADJUSTMENT

EXHIBIT C

HOURLY RATE SCHEDULE ADJUSTMENT

CLASSIFICATION	TOTAL NUMBER OF HOURS	PRESENT CHARGE RATE PER HOUR	TOTAL
Principal Engineer	224	$ 55.00	$ 12,320
Senior Engineer	912	45.00	41,040
Staff Engineer	216	40.00	8,640
Supervisor	776	35.00	27,160
Technician/Draftsman	2,160	27.00	58,320
Assistant Technician	1,392	18.00	25,056
Clerical	288	18.00	5,184
TOTAL			$ 177,720

Total Direct/Indirect Plus Profit = $177,824.50

EXHIBIT D

SUMMARY TASK DESCRIPTION OF REMAINING EUTEK WORK

EXHIBIT D

SUMMARY TASK DESCRIPTION OF REMAINING EUTEK WORK

J 222A-4.2 SPECIAL PILOT SSB ODOR STUDIES

Task I. Monitoring of Pilot SSB Surface Odor Emissions (10 weeks)

Weekly monitoring of unit area surface odor emission rates from pilot SSBs under alternative operational conditions. Concurrent evaluation of pilot SSB surface micrometeorology.

Task II. Monthly Reports (three)

Summary of weekly monitoring results. Interpretation of results relative to alternative operational conditions.

SAC J222A-4.5 DIGESTED SLUDGE PILOT ODOR STRIPPING AND OFF-GAS ODORANT CONTROL PROJECT

Task II. Additional Evaluation of Odor Stripping Alternative (1 month)

Daily odor monitoring of treated and untreated digested sludge; pilot SSBs, and digester off-gas. Both single-pass and closed-loop CSTR vacuum vaporization used for odor stripping. Modification of facility to expedite measurements.

Task III. Off-Gas Odorant Control Evaluation (through December 1)

Selection and evaluation of alternative odor control systems. Reactive chemical scrubbing and carbon adsorption used for control. Results monitored olfactometrically. Composition of off-gas GC monitored before and after treatment. Evaluation of useful life of carbon as influenced by hydrocarbon adsorption.

Task IV. Pilot SSB Surface Odor Emissions (6 months)

Weekly monitoring of surface odor emissions from pilot SSBs fed stripped and unstripped digested sludge. Olfactometric evaluation of unit area odor emission rates. Evaluation of odor emission reduction due to stripping. Monthly progress reports.

Task V. Final Report (one)

Summary of results and final recommendations for Regional odor stripping and off-gas odorant control systems. Cost-effectiveness analysis.

Task VI. Daily Operation and Maintenance at Stripping Facility

Daily requirements for oiling PD pumps, cleaning roto-strainer, and checking mixer operation. Allowance for preventative maintenance of one hour per day.

SAC J222A-4.6 DEVELOPMENT OF ODOR CONTROL CRITERIA FOR LARGE ODOR EMISSION AREAS

Task III. Large Area Odor Emission Studies (through January 1977)

Ground layer micrometeorologicaly measurements of air/liquid Δt, temperature lapse rates, relative humidity, wind velocity, gustiness and direction both at source and downwind. Monitoring of unit area surface odor emission rates and surface micrometeorological parameters. Correlation of downwind odor concentrations under ground layer inversion conditions with micrometeorological conditions and downwind distance. Evaluation of alternative controls including feed sludge odor, basin geometry, wind machines, and artificial barriers.

Task IV. Reports (interim and final)

Interim progress reports on key study results and adjustments in study plan. Conclusions and recommendations of odor control criteria and alternative methods of control of downwind odors from large emission areas.

EXHIBIT E

MAN-DAY LABOR REQUIREMENTS BY TASK

EXHIBIT E

MAN-DAY LABOR REQUIREMENTS BY TASK

JOB # J 222A

CLASSIFICATION	4.2-I	4.2-II	4.5-II	4.5-III	4.5-IV	4.5-V	4.5-VI	4.6-III	4.6-IV	MAN-DAY TOTAL	DIRECT SALARY COST $/HOUR	DIRECT SALARY COST $/MAN-DAY	DIRECT SALARY TOTAL
Principal Engineer		2	10	3	4	3		3.5	2.5	28	24.20	193.60	$ 5,420.80
Senior Engineer	5	10	25	6.5	15	13		18	21.5	114	14.03	112.24	12,795.36
Staff Engineer								27		27	12.10	96.80	2,613.60
Supervisor	20						46	31		97	7.70	61.60	5,975.20
Tech./Draftsman	10	5	41	10	32	12	51	101	8	270	6.82	54.56	14,731.20
Ass't. Technician			30	7	25			112		174	4.40	35.20	6,124.80
Clerical		5	10	2	5	8			6	36	4.40	35.20	1,267.20
TOTALS	35	22	116	28.5	81	36	97	292.5	38	646			$48,928.16
OTHER COSTS ($)													TOTAL COST
Materials	100		3750*				1000*	700*					$ 5,550.00
Outside Services			2350*					2500*					4,850.00
Wind Machine Rental								1100*					1,100.00
Travel Expenses	250*		500*		500*		2275*	1000*					4,525.00
Reports		300*			1600*	2000*			5000*				8,900.00
Chemicals								12000*					12,000.00
OTHER COST TOTALS													$36,925.00

* SEE EXHIBIT H

EXHIBIT F

SUMMARY OF PRESENT & PROJECTED INDIRECT COSTS

EXHIBIT F

SUMMARY OF PRESENT AND PROJECTED INDIRECT COSTS

ALLOWABLE

	TOTAL % OF DIRECT LABOR PRESENT 11/75 - 11/76	TOTAL % OF DIRECT LABOR PROJECTED 11/76 - 11/77
SALARY OVERHEAD		
Payroll Taxes - Employer	10.94	10.94
Pension Plan - 10%	11.05	13.29
Profit Sharing	9.92	9.92
Total Salary Overhead	31.91	34.15
GENERAL & ADMINISTRATIVE OVERHEADS		
Indirect Salaries	62.95	62.95
Rent - Building	8.87	8.87
Rent - Equipment	4.36	6.65
Auto Expenses	5.56	12.18
Seminars & Conventions	1.61	1.61
Dues	.90	.90
Engineering Supplies	3.59	3.59
Insurance	15.11	15.11
Key-Man Insurance	.72	2.55
Lab Expenses	.53	7.22
Legal & Accounting	3.35	3.35
License Expenses	.56	.56
Office Expenses	6.28	6.28
Postage	.60	.60
Repairs & Maintenance	1.66	1.56
Subscriptions & Publications	1.97	1.97
Telephone	6.44	6.44
Research Expenses	8.62	8.62
Travel	3.75	3.75
Training Courses	.76	.76
Utilities	.99	.99
Depreciation	11.06	11.06
Property Taxes	1.20	5.15
Freight	.12	.12
Miscellaneous Expense	1.13	1.13
Total General & Administrative	152.69	174.07
TOTAL ALLOWABLE OVERHEAD	184.60%	208.22%

UNALLOWABLE

Contributions	.55	
Entertainment	2.71	
Promotion Expenses	4.67	
Interest	2.77	
TOTAL UNALLOWABLE OVERHEAD	10.70%	

EXHIBIT G

INDIRECT COST ACCUMULATIONS

EXHIBIT G

INDIRECT COST ACCUMULATIONS

Proposed indirect costs are 34 percent of direct labor for salary overheads and 174 percent of direct labor for general administrative overheads after deduction of unallowable costs. These have been computed as follows:

	PERCENT OF DIRECT LABOR			
	Actual	Unallowable	Adjusted	Proposed
Salary Overheads	34.15	---	34.15	34
General & Administrative Overheads	184.77	10.70	174.07	174
TOTAL	218.92	10.70	208.22	208

The proposed rate is for the year 1977 beginning November 1, 1976. The per diem rate has been computed in accordance with applicable regulations. It is this firm's policy to accumulate indirect costs in accordance with generally accepted accounting principles and applicable federal regulations. Indirect costs are accumulated in a manner allowing identification salary overheads and general and administrative overheads.

Principal's salaries are treated in the same manner as other employee salaries. Direct principal labor to a project is charged to that project. All other principal time is accumulated in allowable indirect costs. The hourly charge rate is computed in the same manner for all employees in accordance with the published hourly charge rate sheet.

EXHIBIT H

SUMMARY OF OTHER DIRECT COSTS

EXHIBIT H

SUMMARY OF OTHER DIRECT COSTS

	ESTIMATED COST
4.2	
1. Replacement of materials for olfactometric and micrometeorological measurements	$ 100.00
2. Travel: 20 trip x 50 miles/trip x .25 $/mile	250.00
3. Report graphics, plates, copying services: 20 page copies/report page x 50 report pages/report x 3 reports x .10/page copy	300.00
4.5	
1. Travel: II: 40 trips x 50 miles/trip x .25/mile	500.00
IV: 40 trips x 50 miles/trip x .25/mile	500.00
VI: 182 trips x 50 miles/trip x .25/mile	2,275.00
2. Report graphics, plates, copying & binding services: II, III, IV: 20 page copy/report page x 100 report pages/report x 8 reports x .10/page copy	1,600.00
V: 50 page copy/report page x 400 report pages/report x 1 report x .10 copy	2,000.00
3. Outside services: II: Sub-contract, Teletek, Modify Control System	2,350.00
4. Materials: II: Vacuum pump, piping, flowmeters, & miscellaneous materials	3,750.00
VI: Maintenance Materials	1,000.00
4.6	
1. Travel: 80 trips x 50 miles/trip x .25/mile	1,000.00
2. Report graphics, plates, copying & binding services: 50 page copy/report page x 1000 report pages/report x 1 report x .10/copy	5,000.00
3. Chemicals: 15 barrels x $400/barrel + 7 additional systems x $850/system	12,000.00
4. Materials: Miscellaneous Materials	100.00
Barriers (Trailers) downwind of single SSB, 3 days x 6 trailers @ $20 per trailer per day + tractor & man rental @ $240	600.00

5. Wind Machine Rental: 100 days @ $10 per day + $5 per hour usage x 20 hours	$ 1,100.00
6. Outside Services: Boom truck, 5 days @ $500 per day	2,500.00

EXHIBIT I

OTHER DIRECT COSTS

EXHIBIT I

OTHER DIRECT COSTS

JOB NUMBER		ORIGINAL BUDGET			REVISED BUDGET TOTAL ESTIMATE	REVISED BUDGET INCREASE
		Budgeted	Spent	Balance		
4.2 SPECIAL PILOT ODOR STUDIES						
4.2-I	Materials	0	0	0	$ 100	$ 100
4.2-I	Travel	0	0	0	250	250
4.2-II	Report Material	0	0	0	300	300
4.5 DIGESTED SLUDGE PILOT ODOR STRIPPING						
4.5-II	Materials & Outside Services	6500	412.06	6088	6100	0
4.5-II	Travel	Not Estimated	139.25	0	500	500
4.5-III	Materials	1000	1093.79	0	0	0
4.5-III	Outside Services	3000	3000.00	0	0	0
4.5-IV	Travel	Not Estimated	0	0	500	500
4.5-IV	Report Material	Not Estimated	0	0	1600	1600
4.5-V	Report Material	Not Estimated	0	0	2000	2000
4.5-VI	Materials	Not Estimated	0	0	1000	1000
4.5-VI	Travel	Not Estimated	0	0	2275	2275
4.6 LARGE SCALE ODOR STUDY						
4.6-III	Materials	Not Estimated	898.19	0	700	700
4.6-III	Outside Services	0	0	0	2500	2500
4.6-III	Wind Machine Rental	1100	96.50	1000	1100	100
4.6-III	Travel	Not Estimated	325.88	0	1000	1000
4.6-III	Chemicals	8900	1498.26	7400	12000	4600
4.6-IV	Report Material	Not Estimated	0	0	5000	5000
TOTALS		$ 20,500	$7463.93	$14,488	$ 36,925	$ 22,425

SUPPLEMENTAL STUDY

SEWAGE SLUDGE PROCESSING
AND DISPOSAL
SACRAMENTO REGIONAL WASTEWATER
TREATMENT PLANT
SEWAGE SLUDGE MANAGEMENT PROGRAM

January 25, 1977

Prepared by:

Sacramento Area Consultants
Sacramento, California

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

January 25, 1977

J231A
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Mr. William N. Anderson
Sacramento Regional Wastewater
Management Program
1101 R Street
Sacramento, California 95814

SEWAGE SLUDGE MANAGEMENT PROGRAM
SUPPLEMENTAL STUDY - SEWAGE SLUDGE PROCESSING AND DISPOSAL
SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT

Submitted herewith is the supplemental study of Sewage Sludge Processing and Disposal for the Sacramento Regional Wastewater Treatment Plant requested by your March 3, 1976 letter to Lyle N. Hoag, General Manager of Sacramento Area Consultants. The information in this study documents the decision making which has taken place since the publication of the June 1975 Solids Study.

The study includes a chronological review of the events which led to the presentation of the February 17, 1976 Revised Work Plan and Proposal for the Sewage Sludge Management Program (SSMP), expands on details of new alternative evaluations and provides a time schedule for critical decisions to assure that adequate sludge processing and disposal facilities will be available when the new regional plant goes into service in 1980. We believe that this submission, and the material on the Revision of SSMP Work Plan and Proposal submitted on December 17, 1976 complete all of the work requested by the comments contained in the March 3, 1976 letter.

We are prepared to answer any questions which may arise from the information submitted herein.

SACRAMENTO AREA CONSULTANTS

Warren R. Uhte
Project Manager

clp

cc: Lyle Hoag
Al Wolfenden
Paul Scheidegger

encl

SUPPLEMENTAL STUDY
SEWAGE SLUDGE PROCESSING AND DISPOSAL
SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT

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SUPPLEMENTAL STUDY
SEWAGE SLUDGE PROCESSING AND DISPOSAL
SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT

BACKGROUND DATA

Work on the Sacramento Regional County Sanitation District's (District) sewage sludge disposal plan began in the fall of 1973 as a direct result of one of a series of requirements set forth by the State Water Resources Control Board (SWRCB) in their concept approval of the March 1973 Project Report for the Sacramento Regional Wastewater Management Program (SRWMP). The best apparent disposal plan for the District was documented in a report entitled "Study of Wastewater Solids Processing and Disposal" formally published in June 1975. Pre-publication copies of this report were submitted to the SWRCB in May 1975, fulfilling their concept approval requirements. The report indicated that the best apparent sludge processing and disposal system would involve digestion, storage and utilization (agricultural reclamation) and would include a Sewage Sludge Management Program (SSMP) which would require approximately four-years of study and an expenditure of approximately 1.2 million 1975 dollars.

In October 1975 a detailed work plan and proposal for the recommended SSMP was submitted to District and SWRCB personnel. This detailed work plan and proposal indicated that the costs for the 4-year SSMP had risen to 2.2 million dollars (including inflation allowances) and that the work would require almost five-years. Over 1.6 million dollars of these costs were to be spent in agricultural use demonstrations which were expected to determine crop compatability, soil assimilation capabilities and environmental constraints for the agricultural reclamation of the stored stabilized sewage sludge.

On November 5, 1975 a seminar covering all aspects of this detailed work plan and proposal was presented to District, SWRCB and other regulatory and informational agency personnel. Feedback from this meeting and from similar meetings and

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discussions with other public agencies and within the District's staff caused both the staff and Sacramento Area Consultants (SAC) to have reservations regarding the viability of using agricultural reclamation as the exclusive means of final sludge disposal.

The wisdom of expending such a large amount of money without any guarantee that the end product of the study would not be negated by regulatory controls which eliminated the cost effectiveness of agricultural reclamation uses was seriously questioned. Much of the agricultural use demonstrations involved long-term basic research which was usually considered nonfundable by the County Board of Supervisors. In addition, the District was unable to determine how much of this basic research would be considered a duplication of efforts already receiving major support from federal and state agencies in the Los Angeles and San Francisco Bay areas. It was also felt that the District could not guarantee acceptance of the agricultural reclamation concept by the nearby agricultural community or acceptance by the District taxpayers of the large land areas which might be required to assure that maximum sludge application rates did not exceed the local soils' ability to safely assimilate the toxic elements, the chlorinated hydrocarbon compounds and the large quantity of nutrients involved.

As a result of these doubts the District sponsored a staff workshop on December 19, 1975 to determine what other sludge processing and disposal alternatives might be applicable to the SRWMP. This workshop selected four alternatives for new cost, energy and land use comparisons. These included an up-dated agricultural reclamation alternative and three new on-site dedicated land disposal alternatives.

Alternative A - Digestion - storage - agricultural reclamation
Alternative B - Digestion - dewatering - local landfill
Alternative C - Digestion - storage - permanent lagoons
Alternative D - Digestion - storage - local liquid landfill

The basis for cost evaluations is the same as that used in the June 1975 Solids Study so that direct comparisons to the evaluations of the study alternatives can be made

Alternative A

Alternative A is exactly the same as Alternative 4 of the June 1975 Solid Study except for the inclusion of digested sludge odor scrubbing facilities and the exclusion of solids distribution basins. The alternative includes a multiple hearth furnace for the incineration of dewatered screenings, grit and thickened scum with incinerator exhaust gases under going cyclonic separation, followed by an afterburner and wet scrubber prior to discharge. Ash from the incinerator would be pneumatically transported to ash storage bins prior to trucking to a sanitary landfill site for final disposal.

Five new 390,000 cu ft digesters and 14 additional seven acre solid storage basins (SSBs) would provide sufficient capacity to process the first 20 years of sewage sludge production. The two systems operating together are expected to provide a final stabilized sludge which will be free of pathogens, virus, debris, and nuisance odors and achieve maximum solids concentration with negligible solids recycled to the sewage treatment process. The new sludge odor scrubbing facilities which have been added in response to the findings of the 1975 SSB diurnal odor studies will assure that digestion odors and non-biodegradable debris is removed from the sludge prior to its discharge into the solid storage basins.

Land application is expected to be by ridge and furrow application to fields prepared by agricultural leveling techniques. Sufficient dredging and boosting pumps would be provided to assure distribution to the agricultural acreage without remote storage facilities. The sludge application work done in October 1975 at a pilot distribution basin indicated the futility of attempting to re-homogenize the storage basins stabilized sludge after it has once been harvested by the dredge and transferred to a distribution basin.

For this comparison of alternatives, recycled liquor treatment is assumed to be similar to the system described for Alternative 4 of the June 1975 Solids Study. Capital costs for all Alternative A items (See Table 1), except the new odor stripping facilities, are assumed to be the same as shown in Table VII-11 of the June 1975 Solids Study. Odor stripping facilities would provide for the removal of digestion odors from up to 800 gpm of digested sludge being transferred to the SSBs. Facilities would include

Table 1. Capital Costs - Alternative A- Digestion, Storage, Agricultural Reclamation

Description	Cost, $
Stage I - Stationary Processing Facilities	
Digestion facilities	4,495,000
Incineration facilities	3,550,000
Solids storage basins	4,000,000
Solids transfer facilities	432,000
Recycled liquor treatment	250,000
Odor stripping facilities	600,000
Total contract cost	13,327,006
Staging allowance	190,000
Contract cost plus staging	13,517,000
Contingencies and engineering	4,055,100
Total stationary processing construction costs	17,572,100
Stage I - Land Application Facilities	
Agricultural reclamation	2,868,600
Existing Facilities	
Existing SSB's	2,555,000
Total existing facilities costs	2,555,000
Stage II Stationary Processing Facilities	
Digestion facilities	1,224,000
Solids storage basins	700,000
Recycled liquor treatment	63,000
Total contract cost	1,987,000
Contingencies and engineering	596,000
Total stationary processing construction costs	2,583,000
Stage II - Land Application Facilities	
Agricultural reclamation	2,868,600

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strippers, roto-strainers and additional transfer pumping equipment. Operational costs for all Alternative A items (see Table 2) except material and supplies and the $100 per acre credit for agricultural utilization, power and fuel, are also assumed to be the same as shown in Table VII-12 of the June 19 Solids Study. Material and supplies and power and fuel have been increased to reflect the increased chemical material and power usage of the odor stripping facilities. Activated carbon is expected to be used to remove the odorant gases, while approximately 3180 Kw hr/day of electrical energy is expected to be used by the mechanical equipment involved with the stripping facilities. The agricultural utilization credit was deleted because of the questionable ability to produce an immediately marketable product under the proposed federal and state utilization guidelines. It is also believed that any money raised by the sale of non-edible agricultural crops will be required to offset the increased cost of farming with District treatment plant personnel.

Annual costs for Alternative A (see Table 3) have been calculated in the same manner as those shown in Table VII-13 of the June 1975 Solids Study. Treatment facilities have been amortized over 25 years at 7 percent interest while land and land application facilities have been amortized over 20 years of 7 percent interest. Final year operational costs have been determined by prorating operational costs for the initial year of Stage II on the basis of projected solids loadings (See Table IX-5 of the June 1975 Solids Study).

Alternative B

This alternative is similar to Alternative 2 of the June 1975 Solids Study except for the final disposition of the dewatered sludge. Alternative B calls for the dewatered digested sludge to be deposited in trenches at a local on-site landfill. As such it represents the first of the new concepts of on-site dedicated land disposal. Instead of the need for a fleet of dump trucks for hauling dewatered sludge to the County's sanitary landfill, this alternative requires additional buffer land to the south of the existing treatment plant site landholdings and the purchase of some heavy earth moving equipment. Screenings, grit and thickened scum is handled exactly as indicated in Alternative A.

Table 2. Operational Costs - Alternative A-Digestion, Storage, Agricultural Reclamation

Description	Cost, $
Stage I - Initial Costs	
Labor and maintenance	503,200
Materials and supplies	111,400
Power and fuel	234,800
Ash hauling	20,000
Recycled liquor treatment	93,500
Land application	275,000
Total operational costs	1,237,900
Stage II - Additional Costs	
Labor and maintenance	80,000
Material and supplies	35,300
Power and fuel	40,200
Ash hauling	5,000
Recycled liquor treatment	23.400
Land application	206,200
Total additional operational costs	390,100
Total Stage II operational costs	1,628,000

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Table 3. Annual Costs - Alternative A-Digestion, Storage, Agricultural Reclamation

Description	Cost, $
Stage I - Initial Annual Costs	
Amortized capital costs	
Stationary processing facilities	1,507,900
Land application facilities	270,800
Existing and planned facilities	219,200
Operational costs	1,237,900
Total annual costs	3,235,800
Stage II - Initial Annual Costs	
Amortized capital costs	
Stage I stationary + land + existing	1,997,900
Stage II stationary	221,600
Stage II land application	270,800
Operational costs	1,628,000
Total annual costs	4,118,300
Final Year of Program	
Amortized capital costs	
Stationary facilities + land	2,490,300
Operational costs	1,791,900
Total annual costs	4,282,200
Total average annual costs	3,759,000
Average cost per ton dry solids	60.24

Six new 390,000 cu ft digesters and 27 vacuum filters would be required to provide the capacity to process the first 20 years of sewage sludge production on a 8-hour/day 5-day/week basis. No attempt has been made to increase filtration productivity, because of the stress around-the-clock disposal of dewatered sludge would place on the operation and maintenance of both the dewatering and ultimate disposal facilities. The 525 acres of new buffer lands would extend District ownership approximately 2600 feet south of the present Sims Road extension of the property line from U.S. highway I-5 to the Western Pacific Railroad. This is expected to maintain a reasonable minimum buffer between plant operations and the property boundary.

Direct burial as a means of final disposal of dewatered digested sludge has been in practice at smaller treatment plants for years. It is really nothing more than the creation of a specially-designed sanitary landfill for the specific purpose of disposing of stabilized sewage sludge. Probably the largest operation of this type of disposal has been in service for the North Shore Sanitary District in Lake County, Illinois since July of 1974. During the shortened first year of shakedown operation, the 271 acre site accepted almost 25,000 wet tons of sludge. The sludge solids content averaged about 25 percent. Impervious clay subsurface conditions exist at the site to protect the groundwater. Extensive monitoring is being employed and the superintendent of the disposal operations is making every effort to assure the surrounding neighborhood of the District's concern to be a good neighbor. Eventually the site is scheduled to be transformed into a park. Land use calculations for the Sacramento regional plant indicate that 470 acres will be required to dispose of its first 20 years of dewatered sludge production. Such land would have to be dedicated in perpetuity for the disposal of sludge,and fenced to limit public access.

Recycled liquor treatment for this comparison of alternatives is assumed to be similar to the system described for Alternative 2 of the June 1975 Solids Study.

Capital costs for all Alternative B items (See Table 4) are assumed to be the same as shown in Table VII-5 of the June 1975 Solids Study. Heavy earth moving equipment costs are expected to replace the large fleet of dump trucks. An additional cost for 525 acres of new buffer land has been added. As assumed in the June 1975 Solids Study, the cost of land has been taken as the purchase price reduced by the present worth of that amount 20 years hence.

Operational costs for Alternative B items (See Table 5) reflect the decrease in manpower, power and fuel and sanitary landfill fees brought about by the use of local disposal sites. The smaller number of dump truck operators are expected to reduce labor and maintenance costs from those shown in Table VII-6 of the June 1975 Solid Study by about $180,000 for Stage I and $60,000 for the additional costs of Stage II, even though some of the operators will be switched to the operation of the backhoe and bulldozers required to provide the cut and cover for the trenching operation. The lesser amount of operating equipment and shorter haul for the dewatered sludge is expected to reduce fuel costs by a little over $30,000 per year during Stage I and slightly over $9,000 per year of the additional costs for Stage II. Materials and supplies and recycled liquor treatment operational costs will remain the same as that shown for Alternative 2 of the June 1975 Solids Study. Sanitary landfill costs for Stage I and II have been eliminated but site monitoring costs have been added. These will include ground and surface water, soils and sludge monitoring and are estimated to total $50,000 for Stage I, with another $10,000 of additional costs added for Stage II.

Annual costs for Alternative B, see Table 6, have been calculated as indicated for Alternative A.

Alternative C

Alternative C represents the second new concept of on-site dedicated land disposal. The wastewater solids processing and storage facilities would be exactly the same as Alternative A but final sludge disposal would be to permanent lagoons. The permanent

Table 4. Capital Costs - Alternative B-Digestion, Mechanical Dewatering, Local Landfill

Description	Cost, $
Stage I - Stationary Processing Facilities	
Digestion facilities	5,619,000
Incineration facilities	4,315,000
Vacuum filtration	4,325,000
Building and controls	2,100,000
Recycled liquor treatment	800,000
Total contract costs	17,159,000
Staging allowance	428,000
Contract costs plus staging	17,587,000
Contingencies and engineering	5,276,000
Total stationary processing construction costs	22,863,000
Stage I - Mobile Processing Facilities	
Dumptrucks, backhoe and bulldozers	1,175,000
Total mobile processing construction costs	1,175,000
Stage I - New Buffer Land	
New buffer land (525 acres)	713,200
Stage II - Stationary Processing Facilities	
Digestion facilities	1,274,000
Vacuum filtration	988,000
Recycled liquor treatment	200,000
Total contract costs	2,462,000
Contingencies and engineering	739,000
Total stationary processing construction costs	3,201,000
Dumptrucks, backhoe and bulldozers	1,075,000
Total mobile processing construction costs	1,075,000

Table 5. Operational Costs - Alternative B-Digestion, Mechanical Dewatering, Local Landfill

Description	Cost, $
Stage I - Initial Costs	
Labor and maintenance	712,000
Materials and supplies	404,000
Power and fuel	242,800
Site Monitoring	50,000
Recycled liquor treatment	143,000
Total Stage I operational costs	1,551,800
Stage II - Additional Costs	
Labor and maintenance	60,000
Materials and supplies	101,000
Power and fuel	30,000
Site monitoring	10,000
Recycled liquor treatment	36,000
Total additional operational costs	237,000
Total Stage II operational costs	1,788,800

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Table 6. Annual Costs - Alternative B-Digestion, Mechanical Dewatering, Local Landfill

Description	Cost, $
Stage I - Initial Annual Costs	
Amortized capital costs	
Stage I Stationary processing facilities	1,961,600
New buffer - land	67,300
Mobile equipment	104,800
Operational cost	1,551,800
Total annual costs	3,685,500
Stage II - Initial Annual Costs	
Amortized capital costs	
Stage I Stationary processing facilities	1,961,600
New buffer - land	67,300
Stage II Stationary processing facilities	274,600
Mobile equipment	133,400
Operational cost	1,788,800
Total annual costs	4,225,700
Final Year of Program	
Amortized capital costs	
Stage I & II Stationary processing facilities	2,236,200
New buffer - land	67,300
Mobile equipment	142,900
Operational cost	1,967,700
Total annual costs	4,414,100
Program average annual costs	4,049,800
Average cost per ton dry weight	64.90

467

lagoons would be approximately 20-feet deep with a 15-foot working depth, would permanently store sludge at an average solids concentration of 12.5 percent and an assumed solids loading of 2900 tons (dry wt) per acre. Such lagoons would have to be located on land dedicated in perpetuity for that purpose, fenced and always maintained with a top cap layer of aerobic liquid to assure the absence of nuisance odors and vector problems. Loading would be intermittent from the storage SSBs. The top cap liquid would be maintained with plant effluent and rainfall.

As indicated above, sludge processing and storage facilities under this alternative are exactly the same as Alternative A. The sludge transfer facilities will be considerably less however, because of the increase flexibility of being able to dispose of the sludge all year around. Only two dredges are assumed to be required, considerably less transfer piping and no booster pumping stations. Additional buffer land is required however to assure that none of the permanent lagoons approach the plant's property boundary. Recycled liquor treatment is expected to also be the same as that required for Alternative A.

Capital costs for Alternative C (See Table 7), are the same as for Alternative A except for the lower solid transfer facility costs, the new permanent lagoon costs and the substitution of additional buffer land costs for Alternative A's agricultural reclamation costs. Permanent lagoon construction is expected to be about the same as SSB construction minus the SSB mechanical equipment, piping and electrical. Approximately 270 acres of land would be required to store the first 20-years of production from the SSBs. The same 525 acres of buffer land required for Alternative B would be involved with Alternative C.

Operational costs for Alternative C (See Table 8) are also very similar to those listed for Alternative A, except for the substitution of lagoon monitoring costs for the land application costs of Alternative A. The slightly higher labor and maintenance, material and supplies, and power and fuel costs reflect the transfer of the dredging costs to plant labor and maintenance from the land application to

Table 7. Capital Costs - Alternative C-Digestion, Storage, Permanent Lagoons

Description	Cost, $
Stage I - Stationary Processing Facilities	
Digestion facilities	4,495,000
Incineration facilities	3,550,000
Solid storage basins	4,000,000
Solid transfer facilities	250,000
Recycled liquor treatment	250,000
Odor stripping facilities	600,000
Permanent lagoons	3,000,000
Total contract cost	16,145,000
Staging allowance	190,000
Contract cost plus staging	16,335,000
Contingencies and engineering	4,900,500
Total stationary processing construction cost	21,235,500
Existing Facilities & New Buffer Land	
Existing facilities	2,555,000
Additional buffer land (525 acres)	713,200
Stage II - Stationary Processing Facilities	
Digestion facilities	1,224,000
Sclids storage basins	700,000
Permanent lagoons	500,000
Recycled liquor treatment	63,000
Total contract cost	2,487,000
Contingencies and engineering	746,100
Total stationary processing construction costs	3,233,100

Table 8. Operational Costs - Alternative C - Digestion Storage, Permanent Lagoons

Description	Cost, $
Stage I - Initial Costs	
Labor and maintenance	520,500
Materials and supplies	125,000
Power and fuel	237,000
Ash hauling	20,000
Recycled liquor treatment	93,500
Lagoon monitoring	30,000
Total Stage I operational costs	1,026,000
Stage II - Additional Costs	
Labor and maintenance	80,000
Material and supplies	35,300
Power and fuel	42,000
Ash hauling	5,000
Recycled liquor treatment	23,400
Lagoon monitoring	8,000
Total additional operational costs	193,700
Total Stage II operational costs	1,219,700

budget. The lagoon monitoring is expected to be pretty much limited to ground and surface water parameters.

Annual costs for Alternative C (See Table 9), have been calculated as indicated for Alternative A.

Alternative D

Alternative D represents the third and final new concept of on-site dedicated land disposal. The wastewater solids processing and storage facilities would again be exactly the same as Alternative A, except that final sludge disposal would be of liquid SSB sludge applied directly to fenced disposal sites as set aside in perpetuity for that purpose. Liquid stabilized sludge from the storage basins would be harvested only during the warm summer months when a high net evaporation is guaranteed. The sludge would be dredged directly from the SSBs and applied onto the disposal sites by ridge and furrow methods. No sludge would ever remain uncovered overnight. It is expected that this method of final disposal would take maximum advantage of the use of solar energy to dewater the stabilized solids and thereby minimize the buildup of sludge on the disposal site. Disposal sites would be loaded at a rate of about 100 tons/acre per year and would be expected to have at least a 40-year life.

While reclamation of solids would be possible with both the other two on-site dedicated land disposal concepts, it is believed the dry oxidized sludge on the Alternative D disposal sites would be much easier to reclaim than the wet material of the other alternatives. It is important to note, however, that all of the dedicated land disposal alternatives could include reclamation if the regulatory restrictions could be met and a market was available.

Alternative D sludge transfer and spreading facilities are not as extensive as the transfer and agricultural reclamation facilities of Alternative A, but they are

Table 9. Annual Costs - Alternative C - Digestion, Storage, Permanent Lagoons

Description	Cost, $
Stage I - Initial Annual Costs	
Amortized capital costs	
Stationary processing facilities	1.822,200
Existing facilities	219,200
Additional buffer land	67,300
Operational costs	1,026,000
Total annual costs	3,134,700
Stage II - Initial Annual Costs	
Amortized capital costs	
Stage I Stationary + existing facilities + buffer lands	2,108,700
Stage II Stationary processing facilities	277,400
Operational costs	1,219,700
Total annual costs	3,605,800
Final Year of Program	
Amortized capital costs	
Stationary facilities + land + existing	2,386,400
Operational costs	1,341,700
Total annual costs	3,728,100
Total average annual costs	3,431,400
Average cost per ton dry solids	54.99

more extensive than the transfer facilities of Alternative C. It is assumed the transfer can be accomplished by three dredges and the spreading by three large farm type tractors. Disposal site preparation will include site leveling, subsurface preparation and run-off catchment. Site monitoring will include ground and surface waters, soils and sludge. Recycling liquor treatment is expected to be the same as that required for Alternative A.

Capital costs for Alternative D (See Table 10) are the same as for Alternative C except for the costs of disposal site preparation (substituted for permanent lagoon construction) and the slightly higher costs for sludge transfer and spreading equipment and piping.

Operating costs for Alternative D, See Table 11, are also pretty much the same as for Alternative C except for the higher labor and maintenance, power and fuel and monitoring costs which reflect the increased manpower and equipment involved in the spreading activities and the greater monitoring effort. The labor and maintenance costs would be considerably higher if the transfer and spreading operation was a year-round operation. It is presently anticipated that the manpower used for the summer sludge transfer and spreading operations will be used for the winter stormwater management program and therefor only one-half its annual cost is reflected in Alternative D operating costs.

Annual costs for Alternative D (See Table 12) have been calculated as indicated for Alternative A.

NEW ALTERNATIVE COMPARISONS

Annual Costs

Comparison of the annual costs for Alternatives A through D (See Table 13) indicate that Alternative D provides the cheapest annual cost and Alternative B the most expensive. Almost $775,000 can be saved each year if Alternative D is selected over Alternative B. Two additional comparisons are possible with

Table 10. Capital Costs - Alternative D-Digestion, Storage, Local Liquid Landfill

Description	Cost, $
Stage I - Stationary Processing Facilities	
Digestion facilities	4,495,000
Incineration facilities	3,550,000
Solid storage basins and disposal site	4,500,000
Solid transfer and spreading facilities	350,000
Odor stripping facilities	600,000
Recycled liquor treatment	250,000
Total contract costs	13,745,000
Staging allowance	190,000
Contract cost plus staging	13,935,000
Contingencies and engineering	4,180,500
Total stationary processing construction cost	18,115,500
Existing Facilities and New Buffer Land	
Existing facilities	2,555,000
Additional buffer land (525 acres)	713,200
Stage II Stationary Processing Facilities	
Digestion facilities	1,224,000
Solids storage basins	700,000
Spreading facilities	100,000
Recycled liquor treatment	63,000
Total contract cost	2,087,000
Contingencies and engineering	626,100
Total stationary processing construction costs	2,713,100

Table 11. Operational Costs - Alternative D - Digestion, Storage, Local Liquid Landfill

Description	Cost, $
Stage I - Initial Costs	
Labor and maintenance	576,700
Materials and supplies	125,000
Power and fuel	245,000
Ash hauling	20,000
Recycled liquor treatment	93,500
Disposal site monitoring	40,000
Total Stage I operation costs	1,100,200
Stage II - Additional Costs	
Labor and maintenance	80,000
Materials and supplies	35,300
Power and fuel	42,800
Ash hauling	5,000
Recycled liquor treatment	23,400
Disposal site monitoring	10,000
Total additional operational costs	196,500
Total Stage II operational cost	1,396,700

Table 12. Annual Costs - Alternative D - Digestion, Storage, Local Liquid Landfill

Description	Cost, $
Stage I - Initial Annual Costs	
Amortized capital costs	
Stationary processing facilities	1,554,500
Existing facilities	219,200
Additional buffer lands	67,300
Operational costs	1,100,200
Total annual costs	2,941,200
Stage II - Initial Annual Costs	
Amortized capital costs	
Stage I Stationary + existing facilities + buffer lands	1,841,000
Stage II Stationary processing facilities	232,800
Operational costs	1,396,700
Total annual costs	3,470,500
Final Year of Program	
Amortized capital costs	
Stationary facilities + land + existing	2,073,800
Operational costs	1,536,400
Total annual costs	3,610,200
Total average annual costs	3,275,700
Average cost per ton dry solids	52.50

Table 13. Costs - Sewage Sludge Processing and Disposal Alternatives - Sacramento Regional Wastewater Treatment Plant

Alternative	Average annual cost	Average cost per ton dry solids[1]
A. Digestion, storage, agricultural reclamation	3,759,000	60.20
B. Digestion, dewatering, local landfill[2]	4,433,600 4,049,800	71.05 64.90
C. Digestion, storage, permanent lagoons	3,431,400	55.00
D. Digestion, storage, local liquid landfill[3]	3,275,700	52.50

[1] Based on 62,400 tons per year, the average solids load over the 20 year program. Solids include screenings, grit, scum, primary and secondary sludge solids and stormwater solids.

[2] Based on trenching operations at plant site. If material hauled to sanitary landfill average annual cost is $4,433,600 and average cost per ton dry solids $71.00.

[3] Based on ridge and furrow or flooding methods of application. For direct injection average annual cost is $3,730,600 and average cost per ton dry solids $59.80.

the footnotes added to Table 13. Footnote 2 provides the annual costs of hauling dewatered sludge to the County's sanitary landfill while footnote 3 provides the annual cost of dedicated land disposal of liquid sludge by the direct injection method. As can be seen by the costs in these footnotes the disposal of dewatered sludge on-site is considerably cheaper than hauling it to the sanitary landfill (almost $400,000 per year). Also, direct injection of liquid sludge into the soils at the disposal site is considerably more expensive than ridge and furrow spreading (almost $450,000 per year). In this latter comparison, it is important to note that the direct injection costs are based on much more reliable production figures than the ridge and furrow costs. More reliable data for ridge and furrow methods will be available by the end of 1977.

Energy Consumption

Energy consumption summaries for each of the alternatives are presented in Tables 14 through 17. These summaries were prepared in the same manner and on the same basis as similar summaries for the alternatives presented in the June 1975 Solid Study. Details of these assumptions may be found in Chapter VIII of that study's report. A comparison of the total thermal energy consumed for each alternative is provided in Table 18. The difference between the alternative with the maximum energy consumption (Alternative B) and the alternative with the minimum energy consumption (Alternative C) is 223 million Btu/day of thermal energy, which is equivalent to the home consumption of about 4,200 persons. By footnote to Table 18 it can be seen that the energy use of direct injection application methods for liquid sludge are quite similar to those predicted for the ridge and furrow application method. These direct injection calculations are based on the 1976 dedicated land disposal studies.

Land Use

Land use comparison of the four alternatives is shown in Table 19. As can be seen from the figures on land used up per year, Alternative D will provide the

Table 14. Consumption of Energy by Alternative A - Digestion, Storage, Agricultural Reclamation

Operation	Electric energy, Kwhr/day			No. 2 fuel oil, gallons/day		
	Onsite	Offsite	Total	Onsite	Offsite	Total
Digesters	12,240	-	12,240	-	-	-
Incineration	6,120	-	6,120	-	-	-
Solids pumping	765	-	765	-	-	-
Basin mixing and agitation	5,440	-	5,440	-	-	-
Odor stripping	3,180	-	3,180	-	-	-
Recycled liquor treatment	680	-	680	-	-	-
Solids distribution	-	-	-	54	-	54
Land application	-	-	-	-	100	100
Chemical production	-	215	215	-	280	280
Chemical hauling	-	-	-	-	10	10
Ash hauling	-	-	-	-	3	3
Total	28,425	215	28.640	54	393	447

Table 15. Consumption of Energy by Alternative B-Digestion Mechanical Dewatering, Local Landfill

Operation	Electric energy, Kwhr/day			No. 2 fuel oil, gallons/day		
	Onsite	Offsite	Total	Onsite	Offsite	Total
Digesters	12,240	-	12,240	-	-	-
Incineration	10,200	-	10,200	-	-	-
Dewatering	10,690	-	10,690	-	-	-
Recycled liquor treatment	2,550	-	2,550	-	-	-
Solids hauling and burying	-	-	-	35	-	35
Chemical production	-	750	750	-	965	965
Chemical transport	-	-	-	-	34	34
Ash hauling	-	-	-	-	3	3
Total	35,680	750	36,430	35	1,002	1,037

480<

Table 16. Consumption of Energy by Alternative C-Digestion, Storage, Permanent Lagoons

Operation	Electric energy, Kwhr/day			No. 2 fuel oil, gallons/day		
	Onsite	Offsite	Total	Onsite	Offsite	Total
Digesters	12,240	-	12,240	-	-	-
Incineration	6,120	-	6,120	-	-	-
Solids pumping	765	-	765	-	-	-
Basin mixing and agitation	5,440	-	5,440	-	-	-
Odor stripping	3,180	-	3,180	-	-	-
Recycled liquor treatment	680	-	680	-	-	-
Land application	-	-	-	54	-	54
Ash hauling	-	-	-	-	3	3
Total	28,425	-	28,425	54	3	57

481<

Table 17. Consumption of Energy by Alternative D-Digestion, Storage, Local Liquid Landfill

Operation	Electric energy, Kwhr/day			No. 2 fuel oil, gallons/day		
	Onsite	Offsite	Total	Onsite	Offsite	Total
Digesters	12,240	-	12,240	-	-	-
Incineration	6,120	-	6,120	-	-	-
Solids pumping	765	-	765	-	-	-
Basin mixing and agitation	5,440	-	5,440	-	-	-
Odor stripping	3,180	-	3,180	-	-	-
Recycled liquor treatment	680	-	680	-	-	-
Solids distribution	-	-	-	54	-	54
Land application	-	-	-	25	-	25
Ash hauling	-	-	-	-	3	3
Total	28,425	0	28,425	79	3	82

482<

Table 18. Thermal Energy Consumption - Sewage Sludge Processing and Disposal Alternatives Stage I Development - Sacramento Regional Wastewater Treatment Plant

Alternative	Total thermal energy consumed million Btu/day	Thermal energy consumed per pound raw solids Btu/lb[1]
A. Digestion, storage, agricultural reclamation	366	1,270
B. Digestion, dewatering, local landfill	535	1,850
C. Digestion, storage, permanent lagoons	312	1,080
D. Digestion, storage, local liquid landfill	315[2]	1,090[2]

[1] Stage I total raw solids 289,000 lbs/day (dry weight).

[2] Based on ridge and furrow or flooding methods of application. For direct injection total thermal energy consumed per day increases to 316 million Btu and thermal energy consumed per pound raw solids increased to 1093 Btu/lb.

483<

Table 19. Land Use - Sewage Sludge Processing and Disposal Alternatives-Sacramento Regional Wastewater Treatment Plant

Alternative[1]	Total land requirements[2] acres	Land used up acres/year[3]
A. Digestion, storage, agricultural reclamation	3610	170
B. Digestion, dewatering, local landfill	470	23.5
C. Digestion, storage, permanent lagoons	480	13.5
D. Digestion, storage, local liquid landfill	510	7.5

[1] Alternative Design Criteria:

Study period - 20 years (all alternatives)

Average annual raw solids production - 62,400 tons/yr (dry wt) (all alternatives).

Average annual storage solids production - 25,300 tons/yr (dry wt) (alternatives A, C and D).

Average annual dewatered solids production - 33,000 tons/yr (dry wt) (alternative B).

[2] Dedicated Land Requirement Assumptions:

Digestion - Negligible (all alternatives)

Storage - 210 gross acres, based on 20 lb vss/1000 sq ft/day (alternatives A, C and D).

Dewatering - Negligible (alternative B).

Agricultural reclamation - 3400 acres, based on 7-1/2 tons/acre/year (alternative A).

Local landfill - 470 gross acres, based on North Shore Sanitary District loading rate of 1400 tons (dry wt)/acre/year-20 year life (alternative B).

Permanent lagoons - 270 gross acres, based on lagoon depth 15 feet, average concentration 12.5% solids, dry wt of solids 70 lbs/cu ft, assumed solids loading 2900 tons (dry wt)/acre lagoon area and 1.54 gross acres/net acre - 20 year life (alternative C).

Local liquid landfill - 300 gross acres, based on application rate of 100 tons (dry wt)/acre/year 253 acres, net (alternative D ridges & furrow or flooding methods) would increase to 350 gross acres for direct injection.

[3]

Digester, dewatering and storage facility life assume to be unlimited. (all alternatives, as applicable).

Agricultural reclamation life for soils in the vicinity of the Regional plant is assumed to be 20 years (alternative A).

Local landfill and permanent lagoon land requirements are based on 20 years of application (alternatives B and C).

Local liquid landfill has no apparent limiting application life. For purpose of this comparison life has been assumed to be 40 years, although this could easily be longer and any use of top soil for reclamation purposes could extend this arbitrary limit idefinitely (alternative D).

least land use impact of all the alternatives. Even when direct injection methods are employed for liquid sludge application, Alternative D still uses only 65 percent of the land required by Alternative C. The most significant comparison of Table 19, however, involves the fact that Alternative D (local liquid landfill) uses less than 5% of the land that would be required by Alternative A (agricultural reclamation).

EVALUATION AND SELECTION OF APPARENT BEST ALTERNATIVE

Evaluation of the cost, energy and land use comparisons for the four new SSMP alternatives indicates the following:

Overall Ratings

Alternatives	Economic Evaluation	Energy Evaluation	Land Use Evaluation
A - Digestion-storage-agricultural reclamation	3	2	4
B - Digestion-dewatering-local landfill	4	3	3
C - Digestion-storage-permanent lagoons	2	1	2
D - Digestion-storage-local liquid landfill	1	1	1

1 - lowest or best 4 = highest or worst

Alternative D is lowest or best in both the economic and land use evaluation as well as best in the energy evaluation. If direct injection land application methods are used for Alternative D, its economic evaluation rating changes to 2 and the economic rating of Alternative C becomes 1 giving both Alternative C and D the same overall rating. It is believed Alternative D should still be selected as the best apparent alternative over Alternative C because of the more acceptable condition of the land after the 20 years of service, the better adaptability of the disposed of solids to reclamation and the lower level of nuisance of liquid landfill disposal over permanent lagoon disposal.

SCHEDULING DECISION MAKING FOR CONFIRMING APPARENT BEST ALTERNATIVE

To assure that the new regional treatment plant has a means of acceptable sewage sludge treatment and disposal when it is placed in service in 1980, it is essential that consideration be given to all the possible conditions that might effect the successful completion of the SSMP. The SSMP is presently scheduled as indicated in Fig. 1. Conditions which may effect this completion are logically divided into three case studies. A description of the ramifications and decision-making requirements for each case study follows.

Case I

If everything proceeds on schedule and the SSB E.I.R. is approved in July of 1978, and the liquid dedicated land disposal E.I.R. is approved in July of 1980, the design and construction schedule of additional SSBs and dedicated land disposal sites will be as shown in Fig. 2. Under these circumstances, the additional SSBs would be ready for service by the 1980 date set for regional plant operation and the dedicated land disposal sites would be ready for operation by the beginning of 1982. The earliest the existing SSBs would be full under normal operation (annual SSB sludge harvest 2000 dry tons/year) would be July of 1980. Under normal operations (annual SSB sludge harvest 2000 dry tons/year) the SSBs available to the regional plant in 1980 would not be full until July of 1982. As can be seen by these dates, the conditions of Case I should easily meet the proposed treatment plant criteria.

Case II

If the SSB E.I.R. process rejects the use of open storage basins, major changes will have to be made to the present SSMP. The liquid dedicated land disposal studies and E.I.R. as presently planned would have to be abandoned and the District would have to complete studies on alternatives of sludge dewatering and the disposal of dewatered sludge prior to the beginning of the design of these facilities. To maintain a reasonable design schedule under these circumstances, we believe it is necessary for the alternative sludge dewatering and dewatered sludge disposal studies to

FIGURE 1
SEWAGE SLUDGE MANAGEMENT PROGRAM SCHEDULE

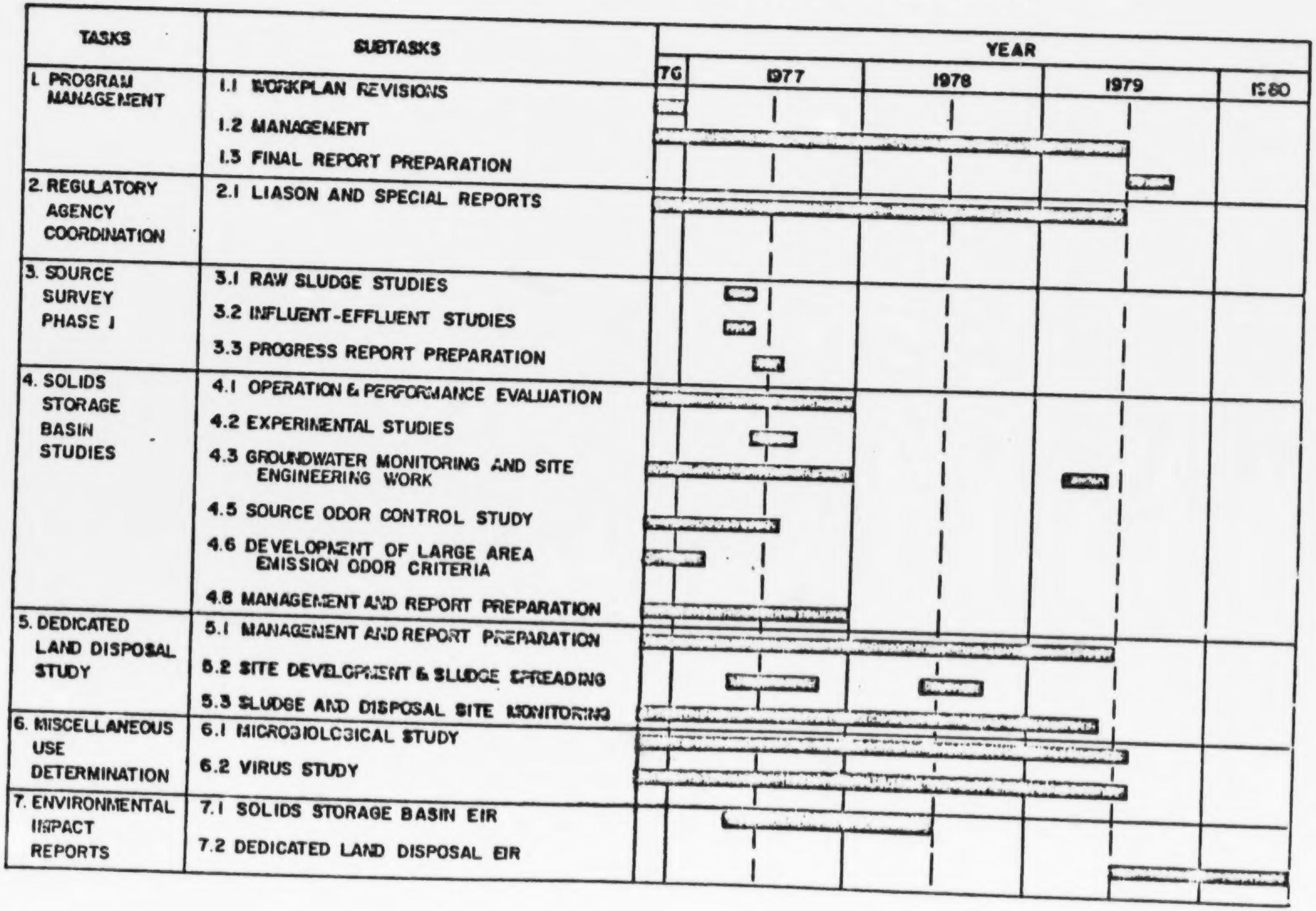
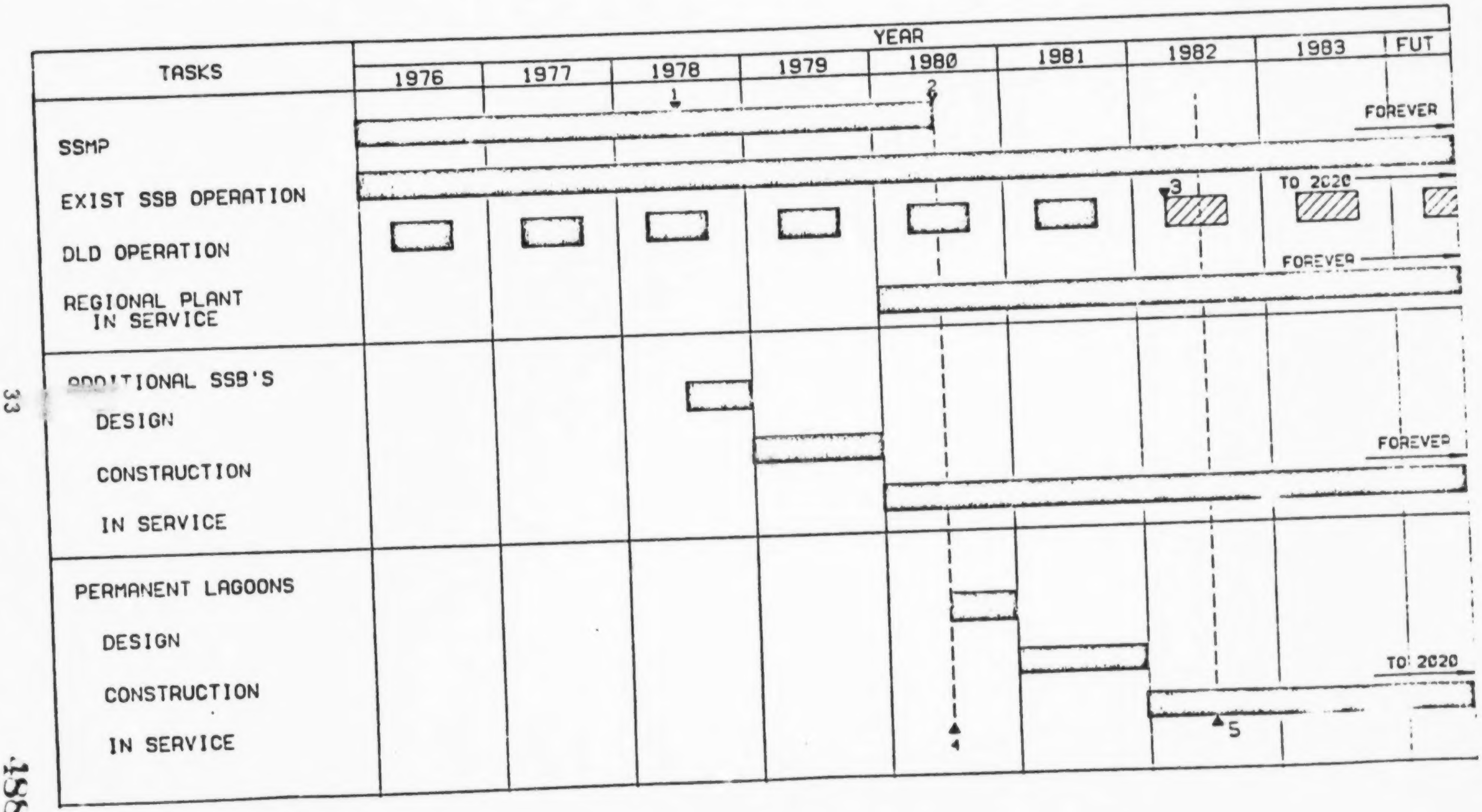


FIGURE 2
CASE I - SSB AND LIQUID DEDICATED LAND DISPOSAL APPROVED AS PLANNED



1. SSB E.I.R. APPROVED
2. DLD E.I.R. APPROVED
3. SSB HARVEST INCREASED TO 25.000 DRY TONS/YEAR
4. EARLIEST EXISTING SSB'S FULL (BASED ON SLUDGE HARVEST RATE OF 2000 DRY TONS/YEAR)
5. LATEST REGIONAL PLANT SSB'S FULL (BASED ON SLUDGE HARVEST RATE OF 2030 DRY TONS/YEAR)

start prior to completion of the SSB E.I.R. process. The critical dates and time periods involved in this decision are shown in Fig. 3.

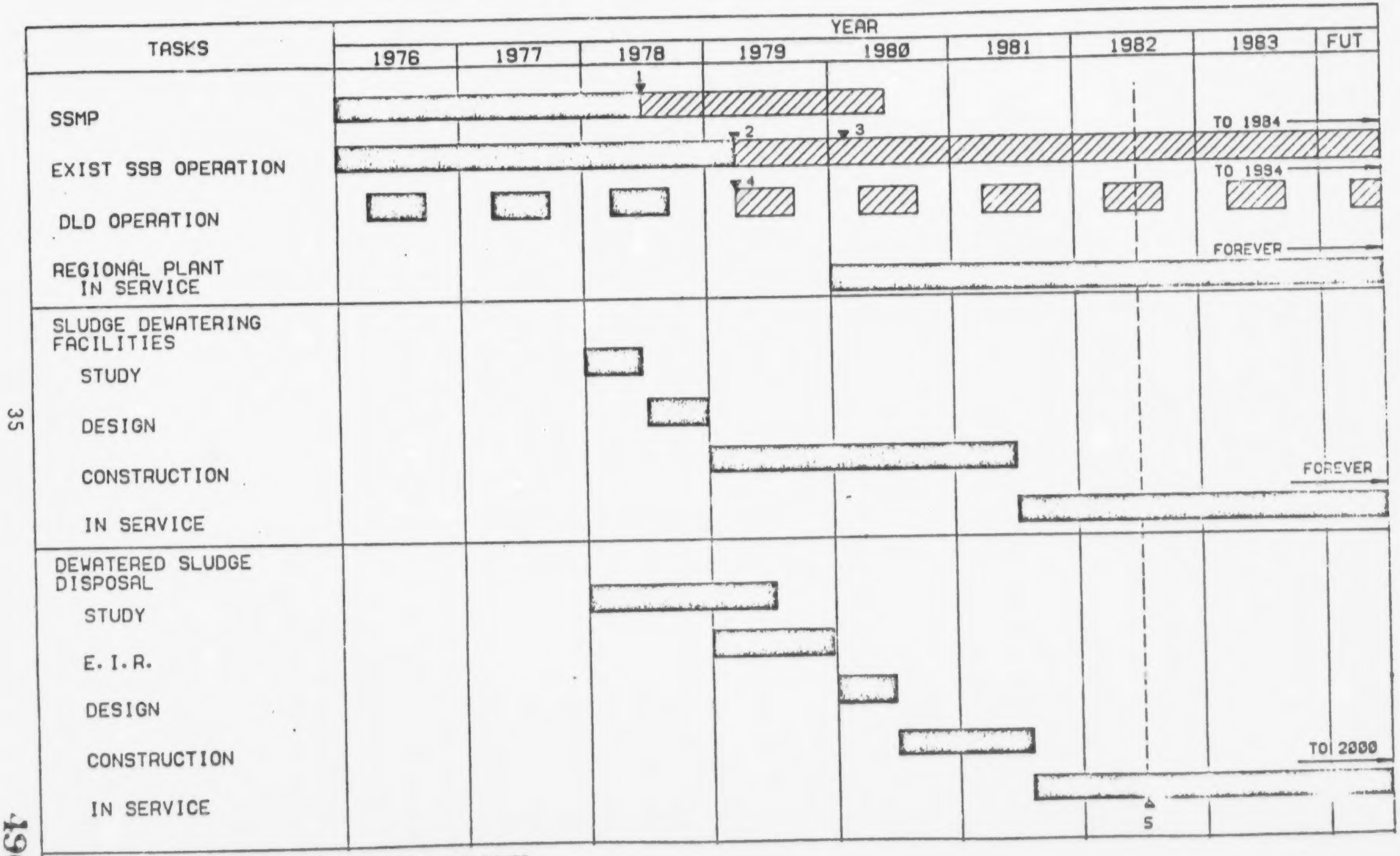
The decision regarding the instigation of these alternatives dewatered sludge studies will have to be made by the District staff in January 1978 after they have been able to review the final reports of the SSB Studies and the SSB E.I.R. The decision should be made on the basis of these reports' ability to convince the staff that the open storage basins will survive the E.I.R. public hearing processes.

If the District staff is not convinced, the alternative sludge dewatering and dewatered disposal studies should be authorized and each scheduled for completion as quickly as possible. The sludge dewatering report should be finished in no more than 6-months. The dewatered sludge alternative is not expected to require an additional E.I.R. because the environmental impact of that alternative will have been thoroughly covered in the SSB E.I.R. Sludge dewatering facility design is expected to take about 6-months and construction, 30-months. This tight schedule may require some of the construction to start prior to the completion of the complete design.

The study of dewatered sludge disposal alternatives will require at least 18-months to complete and will involve a completely new E.I.R. It is expected that the dewatered sludge disposal E.I.R. will start 6-months prior to the completion of the alternative study and complete its public hearing processes 6-months after the study is completed. Design for dewatered sludge disposal facilities is expected to take 6-months and construction approximately 12-months.

If the above schedule can be maintained, the sludge dewatering and dewatered sludge disposal facilities should be in service by July 1981. As indicated in Case I, the existing SSBs would be full under normal operation (annual SSB sludge harvest 2000 dry tons/year) in July of 1980. This full date could be extended to July of 1982 if the annual SSB sludge harvest is increased to 10,000 dry tons/year. To accommodate this higher harvest however, it would be necessary for the District to obtain

FIGURE 3
CASE II - SSB E.I.R. REJECTED



1. SSB E.I.R. REJECTED. EXISTING SSMP ABANDONED
2. SSB HARVEST INCREASED TO 10000 DRY TONS/YEAR
3. SSB LOADINGS EXCEED DESIGN CAPACITY. AEROBIC TOP LAYER DESTROYED.
4. DLD OPERATION INCREASED FROM EXISTING 20 ACRES TO REQUIRED 100 ACRES
5. LATEST EXISTING SSB'S FULL(BASED ON SLUDGE HARVEST RATE OF 10.000 DRY TONS/YEAR AFTER 5/79)

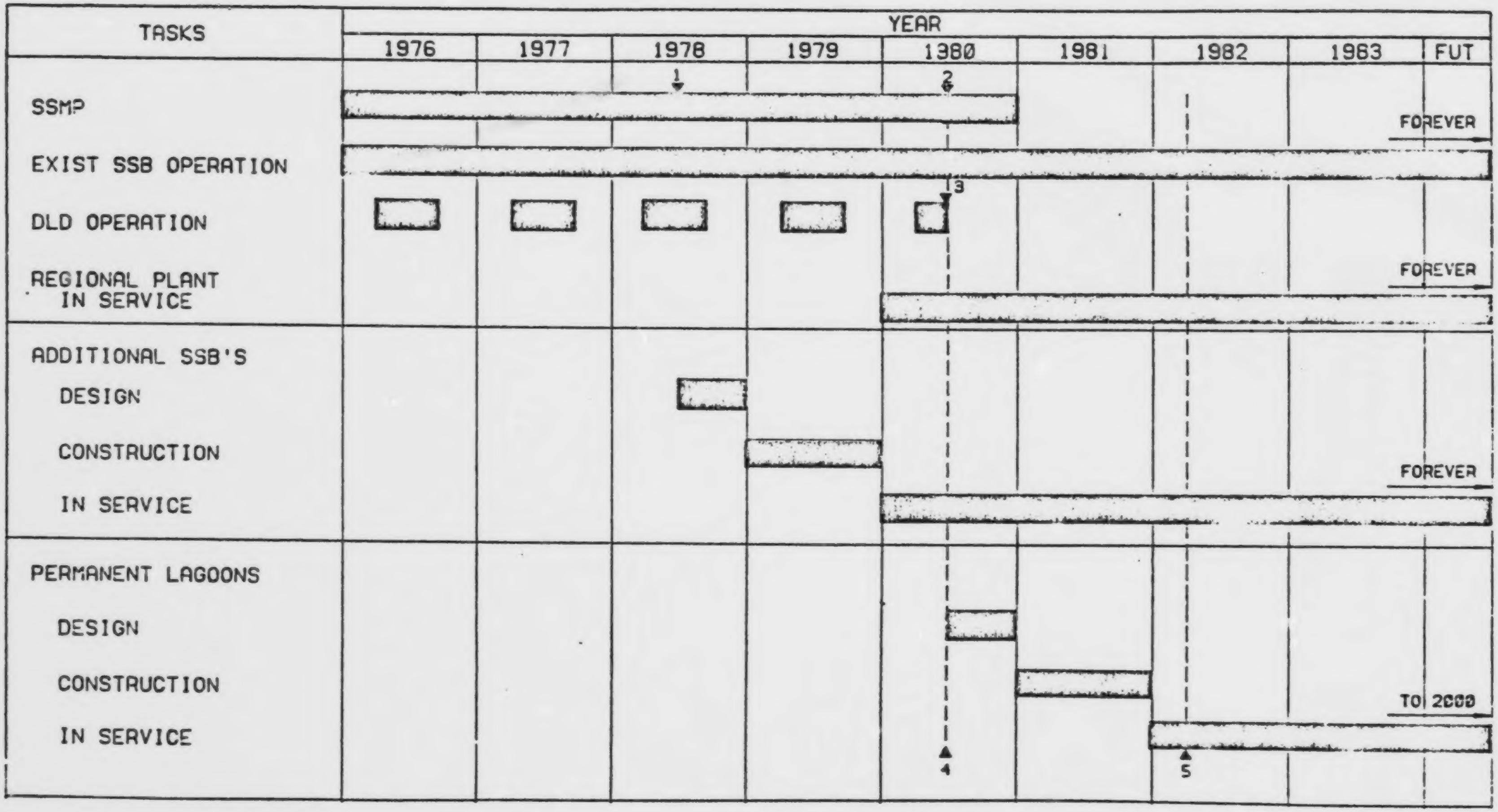
permission from the regulatory agencies to continue existing SSB operation until 1982 and place an additional 80 acres into local liquid landfill service. Additional dredging and spreading equipment would also be required. The existing 40 acres of SSBs would be greatly overloaded when the regional plant was placed in service and it would be impossible to maintain controlled operation (aerobic top surface layers). The liquid landfilling operations would have to be continued even after the dewatered sludge facilities were operable, at least until all the SSBs were empty. It is anticipated that this operation would continue until 1984 at the 10,000 dry ton/year rate. The problems raised by Case II would involve the most costly solutions as well as the most critical scheduling and could easily jeopardize the treatment plant criteria.

Case III

Should the SSB E.I.R. process be successful, but the liquid dedicated land disposal E.I.R. fail, a third schedule of decision-making would be required (See Fig. 4). The design and construction of the SSBs would be scheduled as indicated for Case I. As soon as it is confirmed that liquid land disposal is unacceptable design would begin on the liquid sludge disposal alternative selected by the EIR process as being best. It is assumed at this time, that the permanent lagoon alternative would be selected. If this proves to be correct, it is estimated that the design for the lagoons would take 6-months and construction approximately 14-months. This schedule would provide permanent lagoons for SSB harvested sludge in April 1982. As indicated in Case I, the SSBs available to the regional plant in 1980 would normally not be full until July of 1982 if regular harvesting was allowed. It is expected that all liquid dedicated land disposal would cease in July 1980 when the E.I.R. was rejected. Therefore, it is anticipated that all the SSBs would be full in April 1982. The conditions of Case III, providing all decisions are made as scheduled, would not present any great problem in meeting the proposed treatment plant criteria.

FIGURE 4

CASE III - SSB APPROVED-LIQUID DEDICATED LAND DISPOSAL REJECTED



1. SSB E.I.R. APPROVED
2. DLD E.I.R. REJECTED
3. DLD OPERATIONS CEASE
4. EARLIEST EXISTING SSB'S FULL (BASED ON SLUDGE HARVEST RATE OF 2000 DRY TONS/YEAR)
5. LATEST REGIONAL PLANT SSB'S FULL (BASED ON SLUDGE HARVEST RATE OF 2000 DRY TONS/YEAR THRU 6/80 ONLY)

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED PROGRAM REVISIONS

May 30, 1978

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SACRAMENTO
AREA
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A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

May 30, 1978

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J231B
1.2

RECOMMENDED PROGRAM REVISIONS
SEWAGE SLUDGE MANAGEMENT PROGRAM

Contained herein are the Recommended Program Revisions to the December 10, 1976 Work Plan and Proposal. Since adoption of the December 10 Work Plan, three additional scope changes and one cost change have been added to the Sewage Sludge Management Program as Amendment 10A. The sum of the estimated cost and profit for this work equals the current sum, as of January 1, 1978, total project cost exclusive of work done under the interim Job Authorization Number J222A. Since adoption of Amendment 10A on May 23, 1977, two scope changes, numbers 4 and 5, were approved by the District on September 20, 1977. The costs and profit for the scope changes have been included in this Program Revision.

The new Program Revisions are described in detail in Section 1. The major revisions include the following:

1. Phase II of the Source Survey (Subtask 3.3)
2. Continued SSB performance evaluation and site monitoring (Subtask 4.2 and Subtask 4.3)
3. Expanded odor dispersion monitoring of the SSB's including automatic measurements of the micrometeorological conditions (Subtask 4.6)
4. Design and construction of the Induced Vertical Mixing Systems (Subtask 4.6.1)
5. Preparation of specifications for sludge disposal and tillage equipment and a sludge delivery system (Subtask 5.1)
6. Transfer of Morrison Creek and DLD monitoring to District operations and the development of a long-term DLD monitoring program (Subtask 5.3)
7. Early termination of microbiological and virus studies (Task 6)

Section 2 of the proposal documents the cost impacts of the proposed revisions and describes the methodology for the development of the revised total project cost.

We are prepared to answer any questions you may have on this material.

SACRAMENTO AREA CONSULTANTS

Lyle Hoag

Lyle N. Hoag
General Manager

LNH:AKW:dlb
Attachment

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SECTION 1

SEWAGE SLUDGE MANAGEMENT PROGRAM

DESCRIPTIONS OF RECOMMENDED PROGRAM REVISIONS BY SUBTASK

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 1.1 - AUTHORIZATION PREPARATION AND 1975 STUDIES

This subtask was closed in 1977. No revision will be made to this condition at this time.

Change in Subtask Cost

None

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 1.2 - SSMP MANAGEMENT 1978-1979 PERIOD

This discussion revises and supersedes the discussion presented in the February 9, 1978 Recommended Program Revisions. Management costs for the Sewage Sludge Management Program (SSMP) are expected to continue at about the current rate of $1,500/month for all of 1978 and at least the first two months of 1979. The revision efforts of the last several months, and the additional work required to formulate a new SSMP Detailed Test Plan and the new manhour breakdowns for the third major revision to the overall SSMP work plan are expected to require an additional $3,000. The new SSMP Detailed Test Plan is included here (Table 1-1) because the testing work occurs in several Subtasks as noted in the Table.

Change in Subtask Cost

Estimated additional cost	$3,000

Table 1-1. SSMP Program Management - Detailed Test Plan

Subtask	Sample medium	Sampling/analytical responsibility	Total samples/sampling program		Analytical parameters, units[a]	Analytical method source
			1978	1979 (6 months)		
4.1	Digested sludge	PS/PS[b]	Daily grab of each digester	Daily grab of each digester	Quantity (gpd), total and volatile solids (TS and VS) percent	SM[c]
	SSP surface layer	PS/PS	3 grab samples/basin week	3 grab samples/basin/week	pH, temperature H_2S, D.O.	SM
	SSB surface layer	PS/ESD[d]	48/monthly grab in 8 basins for 6 months	Not recommended	EC, (µmhos/cm), turbidity (NTU), algae count (organisms ml)	SM
	SSB supernatant	PS/PS	When returned to headworks	When returned to headworks	NH_3, TKN, pH, COD, SS, BOD, PO_4	SM
	SSB solids monitoring	SAC and PS/ESD	240/quarterly sampling at 2-ft increments at N-S ends in each basin-16 total basin inventories 6 months	See below	(TS and VS) percent, EC (µmhos/cm), specific gravities	SM
	SSB solids monitoring	PS/PS	240/same as above for six months	Recommended for continuation	(TS and VS) percent, specific gravities	SM
4.3	Groundwater	PS/ESD	40/monthly grab of 8 wells for 5 months	To be determined by Regional Board	Alkalinity, Cl, PO_4, pH hardness, TKN, NH_3-N, organic-N, NO_3-N, NO_2-N COD, pH, EC (µmhos/cm)	SM
	Groundwater	PS/ESD	40/monthly grab of 8 wells for 5 months	Same as above	Same as above	SM
	Groundwater	PS/ESD	8/one months grab of each well for general mineral analysis	Same as above	Alkalinity, Cl, SO_4, HCO_3, Na,K, Ca, Mg, CO_2, hardness, TDS, EC (µmhos/cm) S_iO_2, F, Fe, Mn, turbidity (NTU), pH, TKN, CO_3, NH_3-N, NO_2-N, COD	SM
	Groundwater	PS/PS	8/one months grab for each well for general mineral analysis	Same as above	Same as above	SM
5.3	Harvested sludge	DCB[e]/ESD	6/composite	Completed	Alkalinity, Cl, NH_3-N, sol P, SO_4, (TP and TN) percent dry weight, (B, Ca, Mg, K, Na, Zn, Cu, Cr, As, Pb, Ni, Ag, Cd, Hg, Be, Mo, Se, PCB 1242 and 1254, tech chlordane, other pesticidals) ppm dry weight, Zn Cd ratio, (TS and VS) percent, pH, EC (µmhos/cm)	SM
	Harvested sludge	DCB/ESD	6/composite	Completed	Cd, Pb, Cr, Cu, Zn, DDT, PCB's	EPA[h]

502<

Table 1-1. SSMP Program Management - Detailed Test Plan (continued)

Subtask	Sample medium	Sampling/analytical responsibility	Total samples/sampling program		Analytical parameters, units[a]	Analytical method source
			1978	1979 (6 months)		
[illegible]	Soil	DCB/DCB and ESD	30/to be determined	Transferred to District	Saturation extracts: pH, EC (µmhos/cm), NO_3-N, PO_4-P, SO_4, HCO_3 + CO_3, Cl, Ca, Mg, K, Na, pH, B. DTPA extracts:[g] (Cu, Zn, Cd, Ni) mg/kg Special analysis[g]: CEC (meq/100 gms), TKN, NH_4, TOC Pesticide residues[g]: (Chl. hydrocarbons and PCBs) ug/mg	UCD - DSPN[f] SM UCD - DSPN EPA
	Soil	PS/PS	SAC responsibility	24/to be determined	Same as above	Same as above
5.3	Soil solution	DCB/DCB and ESD	128/16 locations -2 depths 4 times/year	Transferred to District	EC (µmhos/cm), NO_3-N, SO_4, HCO_3 + CO_3, Cl, Ca, Mg K, Na, pH, PO_4-P, B (Chl. Hydro. and PCBs) ug/l (see i) Zn, Cd (see i)	UCD - DSPN
	Soil solution	PS/PS	SAC responsibility	64/16 locations 2 depths 2 times/year	Same as above	UCD - DSPN
	Groundwater	DCB/DCB and ESD	24/12 locations at 2 times/year	Transferred to District	EC (µmhos/cm), NO_3-N, SO_4, HCO_3 + CO_3, Cl, Ca, Mg, K, Na, pH, PO_4-P, B, (Chl. hydrocarbons and PCBs) (ug/l)[j], Zn, Cd	UCD - DSPN EPA - SM
	Groundwater	PS/PS	SAC responsibility	12/12 locations at once/year	Same as above	Same as above
	Surface runoff	DCB/DCB and ESD	12/during rainy season	Transferred to District	EC (µmhos/cm), pH, turbidity (NTU), TKN, NO_3-N, NH_3-N, TP, Cl, NH_4 (Chl. hydrocarbons and PCBs) ug/l Zn, Cu, Cd, Ni, Pb, Hg)	UCD - DSPN EPA - SM
	Surface runoff	PS/PS	SAC responsibility	6/during rainy season	Same as above	Same as above
[illegible]	Creek water	SAC/ESD	30/5 locations each month for 6 months	Transferred to District	Zn, Cu, Cd, Ni, Pb, Hg, TKN, NO_3-N, TPO_4, pH, EC (µmhos/cm), turbidity (NTU), (T. coli, F. coli, and F. strep) MPN/100 ml, NH_3-N (Chl. hydrocarbons and PCBs) ug/l	SM EPA
	Creek water	PS/PS	30/5 locations each month for 6 months	25/5 locations each month for 5 months	Sames as above	SM

---

[a] Units are in mg/l unless otherwise noted.

[b] PS = plant staff.

[c] SM = Standard Methods for the Examination of Water and Wastes, APHA, AWWA, WPCF, 14th ed., 1975.

[d] Environmental Sciences Division.

[e] DCB = Dwight C. Baier.

[f] UCD - DSPN = University of California at Davis - Department of Soils and Plant Nutrition.

[g] 20 percent of total annual samples to receive this analysis.

[h] EPA - Methods of Chemical Analysis of Water and Wastes- U.S. EPA, 1974.

[i] 10 percent of total annual sampler to receive this analysis.

[j] 25 percent of total annual samples to receive this analysis.

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 1.3 - FINAL REPORT PREPARATION

This subtask will be accomplished during the initial months of 1979 instead of the late summer months. Because this is within the same fiscal year, there are no revisions to be made to the subtask budget at this time.

Change in Subtask Cost

None

J231D
2.1-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 2.1 - REGULATORY AGENCY COORDINATION

As regulatory agency coordination work will cease with the early completion of the SSMP on March 1, 1979, it is assumed that at least $2,500 will be saved from its existing budget. It is assumed this money will be available to offset some of the additional costs as part of the extra work contemplated for Task 4.

Change in Subtask Cost

Estimated savings in costs	$2,500

2

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3.3-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 3.3-SOURCE SURVEY PHASE II - ANALYSIS OF SELECTED STORED SAMPLES AND PREPARATION OF PROGRESS REPORT

The discussion of the work to be completed under Subtask 3.3 presented herein supersedes and revises the discussion presented in the February 9, 1978 Recommended Program Revision under Subtasks 3.1, 3.2, and 3.3.

The Phase I Source Survey Progress Report recommended that additional analyses be made of the stored daily raw sludge samples from the Central Treatment Plant and of the daily influent and effluent samples from the City Main Treatment Plant. This additional analytical work budgeted under Subtask 3.1 and Subtask 3.2 in the February 9 Recommended Program Revisions has been included under Subtask 3.3.

The Phase I Source Survey Progress Report recommended that additional sampling and analytical work be completed to identify the sources of unusual concentrations of heavy metals discharged into the sewer system's tributary to the City Main, Central, Rancho Cordova, Natomas, Arden, and Rio Linda treatment plants. The sampling and analytical work would be performed by the District with SAC providing technical or managerial input as required. It is anticipated that the District cost for the Phase II sampling and analytical work would be $15,000.

SAC work under this Subtask would be to provide management and coordination of the sampling and analytical program and the preparation of the Progress Report. The Progress Report should include a summary and interpretation of the data collected, and an identification of sources of heavy metals and chlorinated hydrocarbons. The report should also include a preliminary assessment of the effect that recent EPA Pretreatment Standards and Electroplater Pretreatment Standards will have on the sewage sludge disposal plan and District operations.

The cost of this work is estimated to be as follows:

1) Analyses of stored raw sludge, influent and effluent samples

Sample retrieval	$ 600
Raw sludge	
Cadmium and chromium analysis	375
Influent/effluent	
Lead and nickel analysis	1,950
	$ 2,925*

*These costs had been budgeted under Subtasks 3.1 and 3.2 in the February 9, 1978 Recommended Program Revisions.

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2) Management and report preparation

Labor cost	$12,000
Printing, expendable supplies	1,605
	$13,605

3) Total Subtask cost	$16,530

Change in Subtask Cost

Estimated additional cost	$16,530

4

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.1 - SSB STUDIES CONTINUED SOLIDS STORAGE BASIN OPERATION AND PERFORMANCE EVALUATION PROGRAM

The discussion of the studies to be completed under Subtask 4.1 presented herein supersedes and revises the discussion presented in the February 9, 1978 Recommended Program Revisions. The revision presented herein is in Phase 2 of the SSB Mixer Study; all other elements and costs for the Subtask are unchanged.

As outlined in SSMP Revised Work Plan and Proposal of December 10, 1976, the continuing evaluation of SSB operation and performance was scheduled for completion at the end of 1977. However, the extension of SSB odor work (Subtask 4.6) into 1978 will allow additional time which can be used for supplementary investigative work. This work will consist of monitoring of selected SSB surface layer and stored solids characteristics for an additional six months and experimentation with the operation of surface mixers. The additional investigative work will also evaluate alternative methods of determining the relative solids concentrations in the basins. A summary of this supplementary work is given below. All supervision and other costs to manage this work are included under Subtask 4.8, SSB Study Management, Data Reduction, and Report Preparation.

Surface Layer and Solids Monitoring

Additional SSB surface layer monitoring will consist of monthly samples of the eight SSB's. Each sample will be analyzed for algae count, turbidity, and electrical conductivity (EC). Data from the end of 1977 indicated that the SSB's are entering 1978 with higher resident algae populations than in previous years. It will be of interest to observe the effects of an apparently normal winter on the algae and associated surface layer characteristics. It is also expected that Central Treatment Plant staff will continue their monitoring of the SSB's, which includes routine determinations of surface layer temperature, dissolved oxygen (DO), pH, and sulfides. Continuation of analyses for algae count, turbidity, and EC in the second half of 1978 is considered to be optional for plant personnel.

Basin profiles will be conducted on two occasions during the first six months of 1978. This is a continuation of the SSB quarterly samplings conducted during the past 18 months of the SSMP. All samples will be analyzed for total solids (TS) and volatile solids (VS) with selected samples receiving specific gravity determinations. This information is important in documenting the solids concentration and volatile solids reduction which continues to occur in the SSB's. Samples will not be analyzed for heavy metal or chlorinated hydrocarbon content. It is expected that Central Treatment Plant staff will incorporate this minimum level of SSB solids monitoring into their monitoring program starting in the second half of 1978. Such information will be essential for the District to determine the status of the solids accumulation in the SSB's in order to schedule future sludge harvesting operations.

Sampling and monitoring costs for work carried out by plant staff are considered to be part of the Central Treatment Plant's normal operational expenses.

SSB Mixer Study

Previous work has established the effectiveness of the existing 20-hp surface mixers. In an experiment conducted during the summer of 1977, mixer operation was proven to be essential for successful SSB operation. The normal 12-hour per day mode of operation has resulted in a relatively trouble-free operation. Despite all the information that has been obtained, no documentation exists on the adequacy of smaller mixers in the full-size SSB's or on the effectiveness of operating the large mixers on a reduced schedule of six hours per day. Both of the above would significantly reduce capital and operating costs of future SSB's.

The SSB mixer study will consist of two phases which will be conducted concurrently. SSB's 2, 5 and 6 will be used and will continue to receive their normal daily loading of 20 lbs VS/1000 ft^2/day. A description of the work is given below.

Phase I - Effectiveness of Smaller Mixers

The smaller 3-hp surface mixer that was used in the east pilot SSB during the Source Odor Control Study and the SSB Experimental Studies has been structurally modified and currently is situated in SSB 2. Blades on the mixing rotor of the unit have been modified into a spiral arrangement which is expected to minimize the bearing and drive chain stress. This is accomplished by equalizing and minimizing the number of blades which come in contact with the water surface at any one instance and creating continuous small impacts of a minimum number of blades instead of four large impacts of one quarter of the blades during each revolution. This design feature will be evaluated during the mixer study.

The 3-hp mixer will initially be placed in the southeast corner of SSB 2 and will be operated in lieu of the existing 20-hp mixer on a normal basis of 12 hours per day (6:00 p.m. to 6:00 a.m.). This

6

mixer will be held in place by cables strung the length of the basin and will have the capability of being moved to various locations in the SSB during the study.

This phase of the mixer study is scheduled for four months' duration, from March 1 through July 6 of 1978. The primary objective of this work is to determine the effectiveness of the smaller mixer in SSB operation over an extended period of time. Surface layer monitoring during this time will consist of: (1) routine monitoring by plant staff of surface layer temperature, pH, sulfides and DO; (2) routine monthly analysis for algae count, EC and turbidity; and (3) one diurnal study at two locations in SSB 2 for DO, pH, temperature, and oxidation reduction potential. In addition, plant staff and SAC personnel will routinely observe the effectiveness of the smaller mixer in dispersing surface accumulations of solids and scum.

Another objective of this phase of work will be to determine the effectiveness of this mixer on solids distribution in the basin. SSB 2, with one mixer at the north end, has a disproportionate distribution of stored solids with more solids accumulations in the middle and south end. This, therefore, is the reason for installing the smaller mixer initially at the southeast corner.

During the week prior to March 1, SSB 2 will be sounded at various locations throughout the basin for the purpose of determining the depths to the sludge blanket. This procedure will be repeated after 60 days of the study, at which time the mixer will be moved to the center of the basin where a large "hill" of submerged sludge exists. The mixer will then be operated at that location for an additional 60 days. Upon completion of the study, the basin will be sounded again. This procedure should give an indication of the effect of the smaller mixer on solids distribution.

At one location in the south end of SSB 2, during the initial sounding of the basin, sludge samples will be obtained at two-foot increments from throughout the basin profile and analyzed for TS. This data will be related to various methods of basin sounding. In other words, a given TS concentration will be related to the depth to which a given obstacle penetrates. If successfully done, it is expected this procedure will develop an indirect and inexpensive means of determining the relative solids concentration in a basin.

Phase 2 - Effectiveness of Reduced Mixing

This phase of work will have two objectives. The first objective is to determine the effectiveness of reduced mixer operation in SSB 5. Mixer operation in Basin 5 will be reduced to six hours per day, from 12:00 midnight to 6:00 a.m. while mixer operation in SSB 6 will remain at the normal 12-hours per day schedule. These basins will continue to receive the design loading rate of 20-lb VS/1000 ft^2/day. Total experimental time will also be from March 1 through October 12. Monitoring will consist of routine monitoring by plant personnel of temperature, pH, DO, and sulfides, and monthly analyses for algae count, turbidity, and EC. Plant staff and SAC personnel will also observe the effectiveness of this reduced mixer operation on surface solids and scum accumulations when compared with a similar basin operating at the normal mixer schedule. 6

The second objective of Phase 2 is to evaluate the effectiveness of reducing mixing power in SSB 5. Upon completion of the above work SSB 5 mixers will be modified by removal of blades to reduce their power to about 7.5 to 10-hp. The mixers will then be operated on a normal schedule of 12 hours per day, 6:00 p.m. to 6:00 a.m., for a period of three months. Again, SSB 6 will serve as the "control". Feeding and monitoring procedures will be the same as above. A report will be submitted which will incorporate the results of both Phase 1 and Phase 2 of the SSB mixer study. 7

The following is a schedule for the completion of the SSB studies:

Date	Event
2/28/78	Start of Phase 1 and Phase 2 of mixer study, sound SSB 2, evaluate alternative methods of determining sludge concentrations, reduce operation of SSB 5 mixers to 6 hr/day.
4/27/78	Sound SSB 2, evaluate alternative methods of determining sludge concentration.
5/3/78	Move 3-hp mixer in SSB 2 to center of basin.
7/5/78	Conduct diurnal monitoring study of SSB 2.
7/6/78	Completion of Phase 1 of mixer study, sound SSB 2.
7/6/78	Begin modification of SSB 5 mixers, remove sufficient blades to reduce power to 7.5 to 10 hp.
7/12/78	Completion of modifications, operate SSB 5 mixers 12 hr/day from 6:00 p.m. to 6:00 a.m.
10/12/78	Completion of Phase 2 of mixer study.
10/31/78	Submittal of report.

Program Costs

Surface Layer and Solids Monitoring	
SSB quarterly solids monitoring (SAC)	$ 760
Laboratory	
SSB surface layer	1,155
SSB solids	2,570
Travel - 400 miles	85
Subtotal	$ 4,570
SSB Mixer Study	
Labor	$ 5,450
Field Personnel (Diurnal Study)	150
Laboratory	55
Travel and reproduction	190
Equipment modification and maintenance	3,905
Report preparation	2,150
Subtotal	$11,900

Change in Subtask Cost

Estimated additional costs	$16,470

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.2 - SSB STUDIES SOLIDS STORAGE BASIN EXPERIMENTAL WORK

This subtask work will be complete with the incorporation of District comments into the draft report submitted February 9, 1978. No revisions will be made to this condition at this time.

Change in Subtask Cost

None

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISIONS - SUBTASK 4.3 - SSB STUDIES CONTINUING SOLIDS STORAGE BASIN GROUNDWATER MONITORING PROGRAM AND SITE ENGINEERING WORK

The discussion of the studies to be completed under Subtask 4.3 presented herein supersedes the discussion presented in the February 9, 1978 Recommended Program Revisions. The cost revisions are for additional costs for subconsultants used in the preparation of the "Draft SSB Permeability Report" and an estimate of additional costs to finalize the report.

Groundwater around the existing solid storage basins (SSB's) was first analyzed in September, 1974. Since that time, monthly determinations have been made of each test well to ascertain if any of the SSB contents are entering the surrounding groundwater. Determinations have included semi-annual complete mineral analyses and monthly partial mineral and nitrogen analyses. Some of the wells have shown a gradual increase in electrical conductivity and chloride concentration. This is considered to be the result of a lack of significant rainfall over the last two years or due to an influence exerted by local agricultural irrigation.

A special investigation of SSB permeability was conducted during the summer of 1977. Some of the initial work was as outlined in the February 17, 1976, Revised Work Plan and Proposal. This work included the installation of tensiometers in the bottoms of SSB's 5 and 6 prior to their start-up. In addition, a large barge was brought in for the purpose of taking undisturbed soil samples from SSBs 2 and 6 in increments of 18 inches down to depths of 15 feet below the bottom of the basins. The report on this investigation indicated that, although there had been a slight downward movement of water from SSB's 2 and 6 immediately after start-up, the basins had sealed themselves after only a few months of operation. As a result of these investigations, it was concluded that there had been no significant movement of heavy metals and that SSB's do not pose a threat to groundwater pollution.

In the preparation of this report an additional cost of $5,000 was incurred for consultation with Dr. Burau at U. C. Davis and Dwight C. Baier. It is estimated that an additional $5,000 will be required to complete the final report.

The monitoring of SSB test wells in the SSMP was scheduled for completion at the end of 1977; however, even though it is believed the basins do not constitute a threat to groundwater pollution, it is recommended that the monitoring of the test wells be continued on a monthly basis until a determination is made by the Central Valley Regional Water Quality Control Board as to the necessity of additional monitoring. In so doing, more groundwater quality data will be obtained which should reflect the heavy rainfall that is occurring this winter. Furthermore, it is recommended that SAC be responsible for the coordination of monthly sampling and for the analyses of groundwater samples for the first six months of 1978 only. Thereafter, the responsibility and costs of SSB test well monitoring should be transferred to District operations. Scheduling the monitoring in this manner will allow a smooth transition between SSMP work and District operations for the permanent installation.

As part of the development of information which will prove that the SSB's can meet all the necessary environmental limitations, it is recommended that additional site foundation engineering be accomplished as soon as possible in the area to receive the additional SSB's and the 300-acre dedicated land disposal (DLD) site. It is expected this work will take place in the spring of 1978 and will provide complete information on the site's natural soil and groundwater table conditions. It is estimated that ten test borings will be sufficient to obtain the necessary data for this area. An amount of $8,000 is already included in the SSMP for this purpose. An additional $2,000 is needed because of the expansion of the future DLD site from 166 acres to 300 acres.

All supervision and other costs to manage this work are included under Subtask 4.8 - SSB Study Management, Data Reduction and Report Preparation. It is expected that well sampling will continue to be carried out by the staff of the Central Treatment Plant.

Program Costs

1) Costs for an extension of the SSMP monitoring of the eight SSB test wells for the first six months of 1978:

Monthly partial mineral and nitrogen content	$ 3,100
One complete analysis	980
Additional test borings for SSB and DLD site	2,070
Subtotal	$ 6,150

2) Study of Solids Storage Basin Bottom Permeability

Additional cost incurred for subconsultants	$ 5,000
Estimated cost for completion of final report	
Labor	3,500
Printing, expendable supplies	1,600
Subtotal	$10,100

Change in Subtask Costs

Estimated additional costs	$16,250

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.4 - SSB STUDIES
SOLIDS STORAGE BASIN DIURNAL ODOR MONITORING PROGRAM

Work on this subtask was completed in 1976. No revisions will be made to this condition at this time.

Change in Subtask Costs

None

J231L
4.5-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.5 - SSB STUDIES
SOLIDS STORAGE BASIN SOURCE ODOR CONTROL STUDY

This subtask work will be complete with the submittal of the final report dated February 1978. No revisions will be made to this condition at this time.

Change in Subtask Cost

None

10

J231M
4.6-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.6 - SSB STUDIES DEVELOPMENT OF ODOR CRITERIA FOR LARGE EMISSION AREAS

The discussion of the studies to be completed under Subtask 4.6 presented herein supersedes the discussion presented in the February 9, 1978 Recommended Program Revisions. The major cost revisions are for the addition of ESB odor monitoring to the proposed SSB odor monitoring and the inclusion of J365A, Induced Vertical Mixing System Design under Subtask 4.6.1.

One of the major additional data needs on the environmental impact of the SSB's involves the determination of specific site information on the frequency of inversion conditions and correlation of this data to downwind odor concentrations. Monitoring will also be conducted on the effectiveness of installed initial dispersion systems at the existing SSB's. This Work Plan has been divided into Phases I, II, III and IV and are described as follows:

Phase I
Micrometeorological Monitoring and Analysis of Puff Transport Frequency

This phase includes installation and data reduction of a manual micrometeorological (micro-met) station through August 1, 1978 and the purchase and operation of two automatic micro-met stations from August 1, 1978 through December 1978. Data collected from these stations will be correlated with data collected in Phase II and used in the development of revised odor risk analysis in Phase III.

Phase II
Monitoring of Puff Transport With Induced Vertical Mixing

The initial task of Phase II will be monitoring of the SSB surface odor emission rate and downwind edge odor concentration from June 15 through August 15, 1978. The objective of the second task of Phase II will be the evaluation of the effectiveness of the installed initial dispersion systems at the full scale SSB's. This evaluation will be conducted by adding artificial odorant to the SSB's to determine the puff transport dispersion coefficient (Φ) and to correlate this data to conditions with the SSB monitoring.

Phase III
Preliminary Reassessment of Odor Risk

The objective of this phase will be to make a preliminary reassessment of the odor risk posed on initial results of ΔT and wind speed and direction monitoring during the first four months of 1978.

Phase IV
Odor Evaluation of Combined ESB/SSB System

The object of this phase will be to initially determine the possible synergistic or antagonistic effects of combined ESB and SSB odorants. Concurrent with the SSB monitoring described in Phase II, surface odor emission rates and downwind edge odor monitoring will be conducted on the ESB. This work will be conducted during several ESB filling, emptying, and drying cycles which will simulate ESB operation during Regional Plant operations. The requirements for simulation of the ESB operation are described in the following section entitled "Proposed ESB Operation to Simulate Regional Conditions for Odor Evaluation".

A final evaluation of the ESB odor occurrence will be made utilizing this data and included in a final report scheduled for completion by mid-January 1979.

Estimated Subtask 4.6 Costs

Estimated costs for these revisions are summarized below. Detail subcontractor's costs are documented in the attached Eutek proposal and addendum. SAC costs for review of the interim and final report and review of water quality data collected during ESB operation are included in the Cost Summary.

Program Costs

SAC Management and Review	
Field supervision and review of (E.S.B.) water quality data	$ 6,000
Review of first interim report on odor occurrence risk	500
Review of final report on odor occurrence risk	1,500
Subcontractor (Eutek Inc.) (Detail presented in attached Eutek Proposal)	436,140
Total	$444,140

Change in Subtask Cost

Estimated additional costs	$444,140

EUTEK INC. 1828 TRIBUTE ROAD, SUITE H • SACRAMENTO, CA 95815 • (916) 929-2003
process
development
and
engineering

April 24, 1978

Mr. Warren Uhte
Sacramento Area Consultants
723 "S" Street
Sacramento, CA 95814

RE: REVISED PROPOSAL FOR 1978 ODOR EVALUATION OF COMBINED SSB AND ESB SYSTEM
SACRAMENTO SEWAGE SLUDGE MANAGEMENT PROGRAM

Dear Mr. Uhte:

We are pleased to submit this proposal revising our proposal dated March 8, 1978. The proposal revisions reflect changes made at the request of the Sacramento County DWQ in a meeting held April 10, 1978. The revisions do not reflect any major changes in the scope of the proposed work but reflect a major shift in responsibility for personnel and equipment for the various phases within the work plan from the Sacramento County DWQ to EUTEK.

Revisions to the proposal involving cost changes include the following:

1. Phase II-A - EUTEK, INC. will provide two 2-man DRO crews, lift truck and operator and complete responsibility for completion and management of this phase of work. It has been assumed that the DWQ will provide two DROs.

2. Phase II-B - EUTEK, INC. will provide one 2-man odorant application crew, one 2-man DRO crew, the odorant application system, lift truck and operator, the necessary odorant, and, complete responsibility for the management of this phase of work. Again, it is assumed that the DWQ will provide two DROs, one of which will be a standby DRO.

3. Phase IV-B - EUTEK, INC. will provide two 2-man DRO crews, lift truck and operator, one DRO system and complete responsibility for completion and management of this phase of work. Phase IV-E of the March 8 proposal has been integrated into this phase at no extra cost. The DWQ is assumed to provide one DRO and the necessary construction, coordination and labor for controlling the fill and draw cycles on the ESBs.

4. Phase IV-C of the March 8 proposal has been deleted. It was originally considered an optional phase and it is our understanding that it will no longer be pursued. The revised proposal phases have been renumbered to reflect the elimination of this phase.

5. Phase IV-E of the March 8 proposal has been deleted as a separate phase and included in a revised Phase IV-B. The proposal phases have been renumbered appropriately.

With the above noted revisions, our concerns regarding management of the project with labor from the DWQ will be alleviated. We believe that we can most effectively manage this project with all personnel and equipment responsibilities with EUTEK.

Other revisions to the proposal include the following:

1. The schedule for Phase I-A, B and C has been adjusted for the estimated delivery date of the micromet stations. The delivery date for the first station is estimated to be August 1 with the second station following by approximately three weeks. This results in an additional month of manual data analysis and a decrease in one month of the automatic data analysis. No adjustment in cost has been made from that previously submitted.

2. The schedule for Phase II-A and II-B has been adjusted so that there will be flexibility in measurement of ϕ before and after construction of the barriers. The overall schedule and number of measurement sessions however has remained the same. The flexibility to measure ϕ before barrier construction will require that the artificial odorant application system be started approximately July 1.

No allowance has been made in the proposal for the lease/rental or purchase of wind machines. It has been assumed that this will be taken care of as a part of the IVM work.

Expedited authorization will be needed for the following tasks so that work can proceed in a timely manner:

1. Authorization for on-going work including Phase I-A, I-B, and I-C.

2. Authorization for negotiating lift truck rental for Phase II-A and IV-B so that lifts are available by June 15, 1978.

3. Authorization for training and screening of candidates for summer odor work for Phase II-A and IV-B, to begin June 15.

4. Immediate authorization for Phase III. This work is scheduled to begin May 1.

5. Immediate authorization for Phase IV-A, the synergism/antagonism study of ESB and SSB odorants. This work is scheduled to begin May 15.

The proposed project will provide a comprehensive and realistic evaluation of the effectiveness of barriers and wind machines for the mitigation of odors from SSB and an assessment of odor risks from both the ESB and SSB systems alone and in combination. The project will also develop, through the micromet data acquisition systems, sufficient data to predict the frequency of critical odor transport condition. This information can be used to determine criteria for the operation of odor control equipment.

We will be happy to discuss this proposal with you at any time.

Very truly yours,

EUTEK, INC.

Terry W. Schroepfer

Terry W. Schroepfer

TWS/lkt

cc: Mr. Lyle Hoag
Mr. Al Wolfenden

PROPOSED ODOR WORK FOR 1978

SACRAMENTO SEWAGE SLUDGE MANAGEMENT PROGRAM

Prepared For:

Sacramento Area Consultants
Sacramento, California

April 20, 1978

LIST OF EXHIBITS

Exhibit	Description
A	EPA Form 5700-41
B	Hourly Rate Schedule
C	Hourly Rate Adjustment
D	Summary Task Description
E	Summary of Projected Indirect Costs
F	Indirect Cost Accumulations
G	Summary of Other Direct Costs
H	Standard Provisions of Agreement Between Client and Engineer

EXHIBIT A

EPA FORM 5700-41

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form.)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE: Sacramento Regional County Sanitation District
2. GRANT NUMBER:
3. NAME OF CONTRACTOR OR SUBCONTRACTOR: EUTEK, INC.
4. DATE OF PROPOSAL: April 20, 1978

5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)*:
1828 Tribute Road, Suite H
Sacramento, CA 95815

6. TYPE OF SERVICE TO BE FURNISHED: SAC Odor Studies

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Principal Engineer	640	$	$	
Staff Engineer	1868			
Supervisor	2164			
Technician/Draftsman	1100	See Exhibit B		
Assistant Technician	4712			
Clerical	984			
DIRECT LABOR TOTAL:				$ 93,217.68

8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	TOTALS
See Exhibit E	1.89	$ 93,217.68	$ 176,181.42	
INDIRECT COSTS TOTAL:				$176,181.42

9. OTHER DIRECT COSTS See Exhibit G

a. TRAVEL			ESTIMATED COST	TOTALS
(1) TRANSPORTATION			$ 3,720.00	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$ 3,720.00	

b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	TOTALS
Equipment		$	$ 94,103.00	
Materials			6,075.00	
Report Costs			3,095.00	
Chemicals			4,000.00	
EQUIPMENT SUBTOTAL:			107,273.00	

c. SUBCONTRACTS			ESTIMATED COST	TOTALS
Outside Services			$ 3,000.00	
SUBCONTRACTS SUBTOTAL:			$ 3,000.00	

d. OTHER *(Specify categories)*			ESTIMATED COST	TOTALS
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$113,993.00

10. TOTAL ESTIMATED COST	$383,392.10
11. PROFIT	$ 48,491.84
12. TOTAL PRICE	$431,883.94

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES *(Indicate basis for price comparison)*	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTH:

☒ YES ☐ NO *(If "Yes" give name address and telephone number of reviewing office)*

Environmental Protection Agency Auditors
100 California Street
San Francisco, CA 94111 415-556-1954

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

See Exhibit F

14c.

This proposal is submitted for use in connection with and in response to *(1)* SAC Request. This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* April 20, 1978 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) April 20, 1978
DATE OF EXECUTION

SIGNATURE OF PROPOSER

President
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

EXHIBIT B

HOURLY RATE SCHEDULE

EXHIBIT B

HOURLY RATE SCHEDULE

CLASSIFICATION	DIRECT/INDIRECT COST CHARGE	GROSS PROFIT CHARGE (18%)	CHARGE RATE PER HOUR
Principal Engineer	$ 46.61	$ 8.39	$ 55.00
Senior Engineer	38.14	6.86	45.00
Staff Engineer	33.90	6.10	40.00
Supervisor	29.66	5.34	35.00
Technician/Draftsman	22.88	4.12	27.00
Assistant Technician	15.25	2.75	18.00
Clerical	15.25	2.75	18.00

EXHIBIT C

HOURLY RATE SCHEDULE ADJUSTMENT

EXHIBIT C

HOURLY RATE SCHEDULE ADJUSTMENT

CLASSIFICATION	TOTAL NUMBER OF HOURS	PRESENT CHARGE RATE PER HOUR	TOTAL
Principal Engineer	640	$ 55.00	$ 35,200
Staff Engineer	1,868	40.00	74,720
Supervisor	2,164	35.00	75,740
Technician/Draftsman	1,100	27.00	29,700
Assistant Technician	4,712	18.00	84,816
Clerical	984	18.00	17,712
			$ 317,888

Total Direct/Indirect Plus Profit = $317,890.94

EXHIBIT D

SUMMARY TASK DESCRIPTION

EXHIBIT D

SUMMARY TASK DESCRIPTION

I. MICROMETEOROLOGICAL MONITORING AND ANALYSIS OF PUFF TRANSPORT FREQUENCY

OBJECTIVES

The objectives of this phase of work is to monitor micrometeorological parameters at two locations at the Central Treatment Plant in order to provide an annual data base for the determination of odor risk.

WORK PLAN

Phase A

A single manual ΔT station will be installed and maintained during the period of January through approximately August 1, 1978.

Phase B

Data will be manually analyzed together with data from the existing wind velocity and direction sensor and recorder at the SSBs from January through approximately August 1, 1978.

Phase C

Two automatic micrometeorological monitoring stations will be purchased and installed per the Eutek Systems' proposal dated February 17, 1978. The two stations will be equipped with the cassette data recording option. This phase will include monitoring and maintenance of the micromet digital data acquisition system and analysis of the data recorded. Data analysis will be completed by computer readout and manipulation of data stored on the cassettes. This phase will commence when the automatic stations come on line and will continue through December, 1978. The estimated delivery date for the micromet stations is August 1, 1978.

Phase D

Monthly summaries of results obtained from Phase A, B, and C work will be provided.

Phase E

Summary results of all above phases will be included in an interim report.

SCHEDULE

A tentative schedule is presented on Table D-1.

ESTIMATED COST

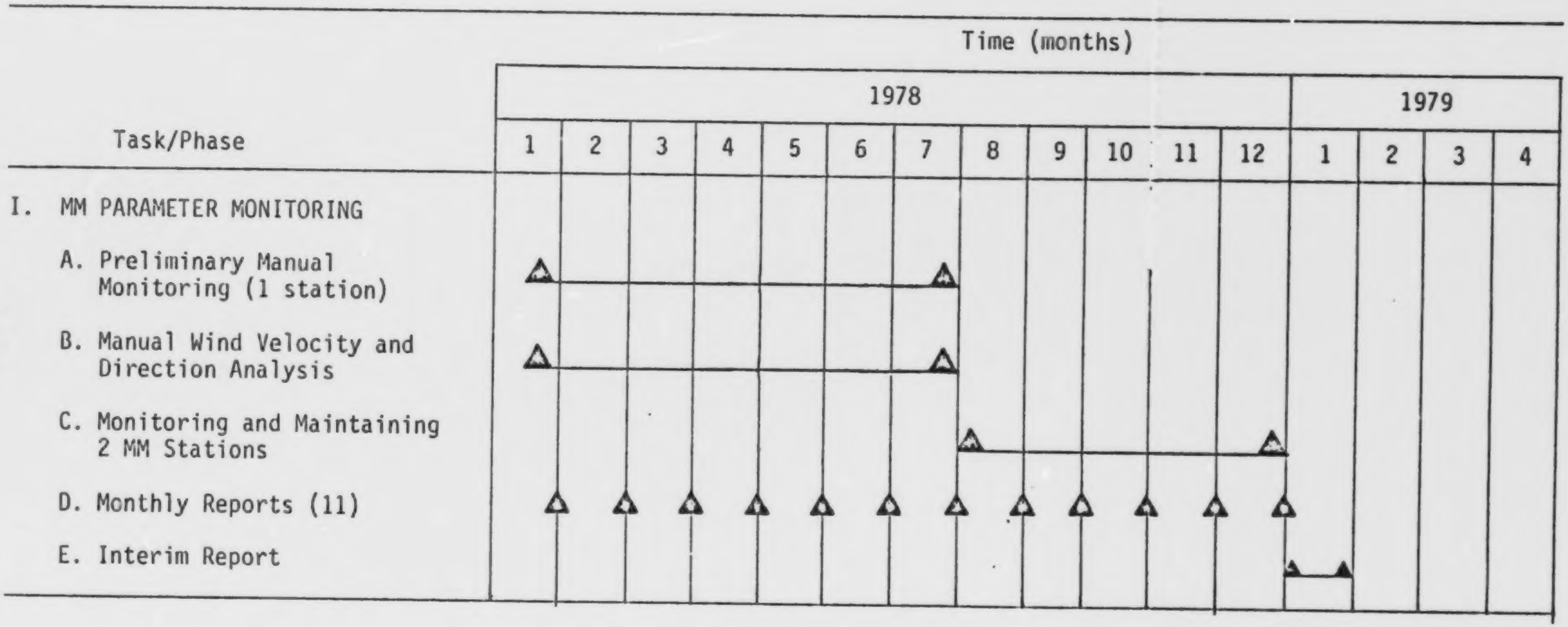
Estimated cost and man-hour requirements are included on Tables D-5A and D-6A.

CRITICAL TIME ITEMS

Authorization for Phase A, B, and D are needed so that ongoing work can continue uninterrupted.

TABLE D-1

TENTATIVE TIME SCHEDULE



II. MONITORING OF PUFF TRANSPORT ϕ WITH INDUCED VERTICAL MIXING

OBJECTIVES

The objective of this phase of work will be to evaluate the effectiveness of the installed initial dispersion systems at the full scale SSBs in accomplishing a net reduction in downwind odor concentrations at the plant property line. These results will be expressed in terms of the puff transport dispersion coefficient, ϕ, previously reported for conditions without initial dispersion. These revised values will then be used together with the results of one full year of monitoring of critical micrometeorological parameters for frequency of strong inversion conditions, and, the surface odor emission rate frequency distribution obtained from the pilot SSBs receiving odor stripped sludge. This analysis would result in a realistic odor risk estimate for the present SSB system and a full scale SSB system.

WORK PLAN

The work plan proposed is based on the SRCSD providing two direct reading olfactometer systems. All other materials, equipment, chemicals and personnel will be provided by EUTEK, INC.

Phase A - SOER and downwind odor monitoring of SSBs.

The SSB unit area surface odor emission rate (kgc*) and downwind edge odor concentration (c*) will be monitored for 40 days. EUTEK, INC. will provide a supervisor, two 2-man DRO crews, and, a lift truck and operator. One DRO crew will measure the surface odor emission rate from the SSBs while the second crew measures downwind edge (c*) and downwind odor concentrations. The lift truck will be used to determine the puff height and vertical concentration profile. The measurements will be taken over a three month period only when artificial odorant is not used.

Sacramento County Requirements:

1. Two DRO systems with power supply.

Phase B - Determination of downwind dispersion coefficient (ϕ) for SSB system with installed initial dispersion system.

The downwind dispersion frequency distribution will be determined for a period of three months (65 days). The frequency distribution obtained can be compared to that obtained in 1976 without wind machines and/or barriers in order to determine the effectiveness of the installed system in increasing the initial dispersion of odors. The dispersion coefficient will be determined by the application of an artificial odorant to the SSBs at a known emission rate. Odors will then be tracked and monitored at downwind locations and profiled vertically to determine the puff height and odor concentration. The dispersion coefficient can be determined from this information. EUTEK, INC. will provide two supervisors, one at the SSBs and one at the downwind odor monitoring locations, one 2-man odorant application crew, one 2-man downwind odor monitoring crew, lift truck and operator and the necessary installation, equipment, and, supplies for the artificial odorant application system. Installation of the artificial odorant application system will begin two weeks prior to the start of the field measurements. The schedule allows the flexibility of measuring ϕ prior to the construction of the barrier system.

Sacramento County Requirements:

1. Two DRO systems with power supply (one standby system).

Phase C

EUTEK, INC. will provide data reduction and analysis as necessary for the above Phases A and B.

Phase D

Utilizing data from the above phases and data from the micrometeorological monitoring an evaluation of odor risk from the SSBs will be made.

Phase E

Summary of results of all above phases will be included in an interim report.

SCHEDULE

A tentative schedule is presented on Table D-2.

ESTIMATED COST

Estimated cost and man-hour requirements are included in Tables D-5A and D-6A. Estimated cost is exclusive of costs for SRCSD equipment and personnel requirements noted previously.

CRITICAL TIME ITEMS

1. Training of personnel for DRO use. (Cost included in price of unit.) One week training required on purchased DROs.
2. Authorization for negotiating lift truck rental will be needed so that lift trucks can be available June 15.
3. Authorization for training and screening of candidates for summer odor work to begin June 15.

TABLE D-2

TENTATIVE TIME SCHEDULE

Task/Phase	Time (months) 1978												1979			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
II. MONITORING OF PUFF TRANSPORT ϕ WITH INDUCED VM																
A. SSB kgc* and c* Monitoring with Micrometeorology to Determine Downwind Edge ϕ Values (2 months)						Δ	—	—	Δ							
B. Artificial Q Values and c Monitoring to Determine Downwind Property Line ϕ Values																
1. MM Monitoring Check								ΔΔ								
2. Set-Up and Equipment Preparation							ΔΔ									
3. Measurements (3 months)							Δ	—	—	—	Δ					
C. Data Analysis											Δ	Δ				
D. Odor Risk Analysis												Δ—Δ				
E. Interim Report												Δ	Δ			

III. PRELIMINARY REASSESSMENT OF ODOR RISK

OBJECTIVES

The objective of this phase of work is to make a preliminary reassessment of odor risk based on initial results of ΔT and wind speed and direction monitoring during the first four months of 1978.

WORK PLAN

The work plan consists of data analysis, odor risk analysis and interim report preparation. An outside consultant with expertise in stable sublayer micrometeorology will be utilized in this effort.

SCHEDULE

A tentative schedule is presented on Table D-3.

ESTIMATED COST

Estimated cost and man-hour requirements are included on Tables D-5A and D-6A.

CRITICAL TIME ITEMS

Immediate authorization is needed so that this work may proceed and be completed within the proposed schedule.

TABLE D-3

TENTATIVE TIME SCHEDULE

Task/Phase	Time (weeks) May, 1978 1	2	3	4
A. Preliminary Reassessment of Odor Risk				
1. Data Analysis	△———△			
2. Consultant		△———△		
3. Odor Risk Analysis			△———△	
4. Interim Report				△———△

IV. ODOR EVALUATION OF COMBINED ESB/SSB SYSTEM

OBJECTIVES

The objective of this phase of work will be to include the ESB system in the evaluation of odor risk for the SSB system so that an evaluation of the combined system risks can be made. An initial evaluation will determine the possible synergistic or antagonistic effects of the combined odorants. The results of this initial study will determine the need for further evaluation. If odors are found to be either additive or synergistic, then the remaining studies will be completed. The odor risk from the ESBs will be evaluated in a similar manner to the SSBs. The operation of the ESB at the future regional plant will be simulated on a restricted volume area in order to determine a frequency distribution of SOER under the proposed operating conditions. Downwind edge odor concentration will be measured to correlate micrometeorological conditions, SOER and observed downwind edge concentration values. Artificial odorant will then be added to the ESBs in a similar manner to the SSBs. Downwind odors and puff height will be monitored to determine the dispersion coefficient ϕ. The results of this analysis will then be used with micrometeorological data acquired throughout the year to make a realistic assessment of combined ESB/SSB odor risk.

WORK PLAN

The work plan presented below is based on the SRCSD providing personnel and/or materials as identified in the specific phase description. Costs and man power requirements for EUTEK are included on Tables D-5B and D-6B. A tentative schedule for the work plan is included on Table D-4.

Phase A - Determination of possible synergistic/antagnostic effects of combined ESB and SSB odorants.

Possible synergistic and antagnostic effects of combined ESB and SSB odorants will be determined by the measurement of separate odor concentrations and then combined odor concentrations. A total of 20 measurement sessions will be completed over 20 separate days, 10 each with odors concentrated by a lab scale vacuum vaporizer and 10 each on natural emitting separate and combined sources dynamically measured with a hood and bucket sample. Results of the study will be presented in an interim report and recommendations will be made on the need for further studies.

Sacramento County Requirements: A single cell of the ESB will need to be filled to obtain ESB water samples.

Phase B - SOER and downwind odor monitoring of ESBs.

A frequency distribution of the ESB SOER will be determined over a two-month (40 day) period. A restricted volume ESB will be utilized to simulate proposed regional plant operations. Several fill and draw cycles will be completed throughout the two-month period. Concurrent with measurement of ESB SOER will be the measurement by an additional crew with a lift truck of downwind odor concentrations from the ESBs. This study will be completed concurrent to Phase II-A on the SSBs.

The SOER monitoring will include, monitoring of the drying surface over a two-week period following the emptying of the ESBs. This will determine the potential odor generation during an extended drying period.

EUTEK, INC. will provide one supervisor, two 2-man DRO crews, lift truck and operator, and, one DRO system with power supply. One DRO crew will measure the SOER on the ESBs while the second crew measures downwind edge and downwind odor concentrations. The lift truck will be used to determine the puff height and vertical concentration profile.

Sacramento County Requirements:

1. One DRO system with power supply.
2. Coordination and labor necessary for controlling fill and draw cycle on ESBs.

Phase C - Determination of odor risk for combined ESB/SSB system based on analysis of specific micrometeorological conditions.

This phase would involve the analysis of the automatic micrometeorological data to determine the frequency of occurrence of micrometeorological conditions that will result in the critical overlap of ESB and SSB odor plumes. The computer program that will be used to analyze cassette data will be modified to determine the specific frequency of occurrence of the combination of events that will result in critical odor conditions for the combined ESB/SSB system.

Sacramento County Requirements: None.

Phase D - Data reduction and analysis.

Data reduction and analysis will be provided for the above phases as needed.

Sacramento County Requirements: None.

Phase E - Evaluation of combined ESB/SSB odor risk.

This phase will be integrated with Phase II-D to include an analysis of the combined effect of the ESB and SSB system on odor risk. Estimated costs are in addition to costs estimated for Phase II-D.

Sacramento County Requirements: None.

Phase F - Summary report.

The results of the above phases will be summarized and integrated into the report provided in Phase II-E. Estimated costs are in addition to costs estimated for Phase II-E.

Sacramento County Requirements: None.

CRITICAL TIME ITEMS

1. Immediate authorization for Phase IV-A is needed so that work can proceed without delay.
2. Authorization is needed for negotiation of lift truck rental so that lift trucks can be available by June 15.
3. Authorization for training and screening of candidates for summer odor work to begin June 15.

544<

TABLE D-4

TENTATIVE TIME SCHEDULE

Task/Phase	Time (months)									
	1978								1979	
	5	6	7	8	9	10	11	12	1	2
IV. ODOR EVALUATION OF COMBINED ESB/SSB SYSTEM										
A. Synergistic/Antagonistic Evaluation	▲	▲								
B. SOER and Downwind Monitoring of ESBs		▲	—	▲						
C. Analysis of Specific Micro-meteorological Conditions							▲▲			
D. Data Reduction and Analysis				▲	▲					
E. Evaluation of Combined ESB/SSB Odor Risk								▲ ▲		
F. Summary Report								▲	▲	

TABLE D-5A

SUMMARY OF ESTIMATED COSTS ($) - PHASES I, II, & III

	JANUARY - JULY						JUNE - DECEMBER						PROJECT TOTALS
Phase	Materials	Travel	Equipment	Outside Consultants	Services	Total	Materials	Travel	Equipment	Outside Consultants	Services	Total	
I-A		375	5,000		19,392	24,767							$ 24,767
I-B	750	330			24,452	25,532							25,532
I-C							225	165	66,000		10,184	76,574	76,574
I-D					6,800	6,800	1,320				10,580	11,900	18,700
I-E							325				4,668	4,993	4,993
II-A								600	6,000		41,080	47,680	47,680
II-B							9,000	1,000	9,000		83,860	102,860	102,860
II-C											15,144	15,144	15,144
II-D											9,720	9,720	9,720
II-E							950				12,056	13,006	13,006
III-A							100	500		2,000	8,408	11,008	11,008
TOTALS	750	705	5,000		50,644	57,099	11,920	2,265	81,000	2,000	195,700	292,885	$ 349,984

Total Other Direct Costs	$ 103,640
Total Eutek Services	246,344

TABLE D-5B

SUMMARY OF ESTIMATED COSTS ($) - PHASE IV

MAY - DECEMBER

Phase	Materials	Travel	Equipment	Outside Services	Eutek Services	Phase Total
IV-A		250	833		8,660	$ 9,743
IV-B		500	7,270		41,080	48,850
IV-C				1,000	2,256	3,256
IV-D					7,620	7,620
IV-E					5,640	5,640
IV-F	500				6,288	6,788
TOTALS	500	750	8,103	1,000	71,544	$ 81,897

Total Other Direct Costs	$ 10,353.00
Total Eutek Services	71,544.00
	$ 81,897.00

TABLE D-6A

MAN-DAY REQUIREMENTS FOR PHASES I, II, AND III

Classification	I-A	I-B	I-C	I-D	I-E	II-A	II-B	II-C	II-D	II-E	III	Man-Days All Phases	Total Hours	Direct $/Hour	Direct Salary Totals
Principal Engineer	4	4.5		5.5	1.5	5	9	12	5	7	7	60.5	484	30.35	$ 14,689.40
Staff Engineer	9	30.5	7.5	22	6	10	61.5	18	10	15	9	198.5	1,588	11.56	18,357.28
Supervisor	28	40	26			40	68.5					202.5	1,620	7.28	11,793.60
Tech./Draftsman	30			22	5			19	20	10	6	112	896	7.00	6,272.00
Ass't. Technician						160	269					429	3,432	5.00	17,160.00
Clerical	3	10.5	3.5	22	7	10	16			14	8	94	752	5.27	3,963.04
TOTALS	74	85.5	37	71.5	19.5	225	424	49	35	46	30	1,096.5	8,772		$ 72,235.32
Other Direct Costs*															
Outside Consultants											2,000				$ 2,000.00
Equipment	5,000		66,000			6,000	9,000								86,000.00
Report Costs				1,320	325					950					2,595.00
Materials		750	225				5,000				100				6,075.00
Travel	375	330	165			600	1,000				500				2,970.00
Chemicals							4,000								4,000.00
*See Exhibit G															$ 103,640.00

TABLE D-6B

MAN-DAY REQUIREMENTS FOR PHASE IV

Classification	IV-A	IV-B	IV-C	IV-D	IV-E	IV-F	Man-Days All Phases	Total Hours	Direct $/Hour	Direct Salary Tota
Principal Engineer	1.5	5	1	4	4	4	19.5	156	30.35	$ 4,734.60
Staff Engineer	4	10	5	6	5	5	35	280	11.56	3,236.80
Supervisor	15	40		7	3	3	68	544	7.28	3,960.32
Tech./Draftsman	10			7.5	5	3	25.5	204	7.00	1,428.00
Ass't. Technician		160					160	1,280	5.00	6,400.00
Clerical	2.5	10	1.5	2.5	2.5	10	29	232	5.27	1,222.64
TOTALS	33	225	7.5	27	19.5	25	337	2,696		$ 20,982.3
Other Direct Costs*										
Travel	250	500								$ 750.0
Equipment	833	7,270								8,103.0
Outside Services			1,000							1,000.
Report Costs						500				500.
										$ 10,353.

*See Exhibit G

EXHIBIT E

SUMMARY OF PROJECTED INDIRECT COSTS

EXHIBIT E

SUMMARY OF PROJECTED INDIRECT COSTS

CATEGORY	TOTAL % OF DIRECT LABOR
SALARY OVERHEAD	
Indirect Salaries	58.69
Employer Payroll Taxes	7.59
10% Pension Plan	13.24
Total Indirect Salary Expenses	79.52
GENERAL AND ADMINISTRATIVE OVERHEADS	
Dues	1.26
Group Medical Insurance	10.92
Business Liability Insurance	12.64
Legal & Accounting Expense	3.32
Licenses	.43
Pension Administration Expense	2.48
Postage	1.14
Professional Fees	2.26
Rent	9.56
Rental of Equipment	4.80
Maintenance	2.28
Property Taxes	1.44
Telephone	3.40
Utilities	1.11
Auto Expense	8.82
Conventions & Seminars	2.04
Engineering Supplies	6.87
Experimental Expense	7.90
Freight	.54
Laboratory Expense	8.55
Office Expense	7.90
Subscriptions	2.65
Travel Expense	7.32
Total General and Administrative Expenses	109.63
TOTAL ALLOWABLE OVERHEAD	189.15%
UNALLOWABLE EXPENSES	
Contributions	.22
Entertainment	1.80
Interest	1.55
Promotion	6.42
TOTAL UNALLOWABLE OVERHEAD	9.99%

EXHIBIT F

INDIRECT COST ACCUMULATIONS

EXHIBIT F

INDIRECT COST ACCUMULATIONS

Proposed indirect costs are 79.52 percent of direct labor for salary overheads and 109.63 percent of direct labor for general and administrative overheads after deduction of unallowable costs. These have been computed as follows:

	PERCENT OF DIRECT LABOR			
	Actual	Unallowable	Adjusted	Proposed
Salary Overheads	79.52	--	79.52	79.52
General & Administrative Overheads	119.62	9.99	109.63	109.48
TOTAL	199.14	9.99	189.15	189.00

The proposed rate is for the year 1978 beginning January 1, 1978. The per diem rate has been computed in accordance with applicable regulations. It is this firm's policy to accumulate indirect costs in accordance with generally accepted accounting principles and applicable federal regulations. Indirect costs are accumulated in a manner allowing identification of salary overheads and general and administrative overheads.

Principal's salaries are treated in the same manner as other employee salaries. Direct principal labor to a project is charged to that project. All other principal time is accumulated in allowable indirect costs. The hourly charge rate is computed in the same manner for all employees in accordance with the published hourly charge rate sheet.

EXHIBIT G

SUMMARY OF OTHER DIRECT COSTS

EXHIBIT G

SUMMARY OF OTHER DIRECT COSTS

Phase	Description	Estimated Cost
I-A	ΔT Tower	$ 5,000
	Travel Expenses	375
I-B	Materials	750
	Travel Expenses	330
I-C	Two Automatic Monitoring Stations	66,000
	Materials	225
	Travel Expenses	165
I-D	Report Costs	1,320
I-E	Report Costs	325
II-A	Lift Truck & Operator For 2 Months	6,000
	Travel Expenses	600
II-B	Lift Truck & Operator For 3 Months	9,000
	Odorant Application Materials	5,000
	Chemicals	4,000
	Travel Expenses	1,000
II-E	Report Costs	950
III	Outside Consultant Services	2,000
	Materials	100
	Travel Expenses	500
IV-A	Travel Expenses	250
	DRO Lease (1 unit with pre-dilutor for 1 mo.)	833
IV-B	Travel Expenses	500
	DRO Lease (1 unit without pre-dilutor for 2 mos.)	1,270
	Lift Truck & Operator For 2 Months	6,000
IV-C	Computer Programming	1,000
IV-F	Report Cost	500
	TOTAL ESTIMATED OTHER DIRECT COSTS	$ 113,993

EXHIBIT H

STANDARD PROVISIONS OF AGREEMENT BETWEEN CLIENT AND ENGINEER

STANDARD PROVISIONS OF AGREEMENT BETWEEN CLIENT AND ENGINEER

Form BM 73-1C © 1973 by California Council of Civil Engineers & Land Surveyors

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811 Forum Building, Sacramento, California 95814

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The client and engineer agree that the following provisions shall be a part of their agreement:

1. The client binds himself, his partners, successors, executors, administrators, and assigns to the engineer to this agreement in respect to all of the terms and conditions of this agreement.

2. In the event that the plans, specifications, and/or field work covered by this contract are those required by various governmental agencies and in the event that due to change of policy of said agencies after the date of this agreement, additional office or field work is required, the said additional work shall be paid for by client as extra work.

3. In the event that any staking is destroyed by an act of God or parties other than engineer, the cost of restaking shall be paid for by client as extra work.

4. In the event of any increase of costs due to the granting of wage increases and/or other employee benefits due to the terms of any new labor agreement during the lifetime of this agreement, such increase shall be adjusted to all fees.

5. The client shall pay the costs of checking and inspection fees, zoning and annexation application fees, assessment fees, soils engineering fees, soils testing fees, aerial topography fees, and all other fees, permits, bond premiums, title company charges, blueprints and reproductions, and all other charges not specifically covered by the terms of this agreement.

6. All tracings, survey notes, and other original documents as instruments of service are and shall remain the property of the engineer, except where by law or precedent these documents become public property.

7. Should litigation be necessary to enforce any term or provision of this agreement, or to collect any portion of the amount payable under this agreement, then all litigation and collection expenses, witness fees and court costs, and attorney's fees shall be paid to the prevailing party.

8. Fees and all other charges will be billed monthly as the work progresses, and the net amount shall be due at the time of billing.

9. A late payment FINANCE CHARGE will be computed at the periodic rate of 0.833% per month, which is an ANNUAL PERCENTAGE RATE of 10%, and will be applied to any unpaid balance commencing 30 days after the date of the original invoice.

10. In the event of any litigation, client agrees to pay to engineer interest on all past due balances at the rate of ten per cent per annum.

11. Client hereby agrees that the balance as stated on the billing from the engineer to client is correct, conclusive and binding on the client unless client within ten (10) days from the date of the making of the billing notifies engineer in writing of the particular item that is alleged to be incorrect.

12. In the event all or any portion of the work prepared or partially prepared by the engineer be suspended, abandoned, or terminated, the client shall pay the engineer for the work performed on an hourly basis, not to exceed any maximum contract amount specified herein.

13. In the event that client institutes a suit against engineer because of any failure or alleged failure to perform, error, omission, or negligence, and if such suit is not successfully prosecuted, or if it is dismissed, or if verdict is rendered for engineer, client agrees to pay engineer any and all costs of defense, including attorney's fees, expert witnesses' fees, and court costs and any and all other expenses of defense which may be needful, immediately following dismissal of the case or immediately upon verdict being rendered in behalf of engineer.

14. Neither the client nor engineer shall assign his interest in this agreement without the written consent of the other.

15. The engineer makes no representation concerning the cost figures made in connection with maps, plans, specifications, or drawings other than that all cost figures are estimates only and the engineer shall not be responsible for fluctuations in cost factors.

16. In the event of litigation on this agreement, the interpretation thereof, and all disputes or controversies arising hereunder shall be governed by the laws of the State of California.

17. No conditions or representations, altering, detracting from, nor adding to the terms hereof shall be valid unless printed or written hereon or evidenced in writing by either party to this agreement and accepted in writing by the other.

18. All agreements on engineer's part are contingent upon, and engineer shall not be responsible for damages or be in default or be deemed to be in default by reason of, delays in performance by reason of strikes, lockouts, accidents, acts of God and other delays unavoidable or beyond engineer's reasonable control, or due to shortages or unavailability of labor at established area wage rate or delays caused by failure of client or client's agents to furnish information or to approve or disapprove engineer's work promptly, or due to late or slow, or faulty performance by client, other contractors, or governmental agencies, the performance of whose work is precendent to or concurrent with the performance of engineer's work. In the case of the happening of any such cause of delay, the time of completion shall be extended accordingly.

19. In the event that litigation be instituted under the terms and conditions of this agreement, the same is to be brought and tried in judicial jurisdiction of the court of the county in which the engineer's principal place of business is located and client waives the right to have the suit brought, or tried in, or removed to any other county or judicial jurisdiction.

20. Engineer does not guarantee the completion or quality of performance of contract or the completion or quality of performance of contracts by the construction contractor or contractors, or other third parties, nor is he responsible for their acts or omissions.

21. Engineer makes no warrant, either express of implied, as to its findings, recommendations, specifications, or professional advice except that these were promulgated after being prepared in accordance with generally accepted engineering practices and under the direction of registered professional engineers.

22. Client agrees to cooperate in any and every way or manner with engineer on project.

23. Engineer makes no representations concerning soil conditions unless specifically included in writing in this agreement, and he is not responsible for any liability that may arise out of the making or failure to make soil surveys, or sub-surface soil tests, or general soil testing.

24. Engineer makes no representations concerning estimates of areas. Estimates of areas are estimates only and are not intended as accurate unless such area is certified. Certified areas will only be given when requested in writing and at an additional charge to client.

25. In the event that any changes are made in the plans and specifications by the client or persons other than the engineer, which affects the engineer's work, any and all liability arising out of such changes is waived as against the engineer and the client assumes full responsibility for such changes unless client has given engineer prior notice and has received from engineer written consent for such changes.

26. The engineer is not responsible, and liability is waived by client as against engineer, for use by client or any other person of any plans or drawings not signed by engineer.

27. In consideration of the engineer's fee for services, the client agrees that the engineer will perform no on-site construction review for this project; that such services will be provided by others; and that the client shall defend, indemnify and hold the engineer harmless from any and all liability, real or alleged, that might be occasioned by others performing construction review for this project.

28. The client agrees that in accordance with generally accepted construction practices, the construction contractor will be required to assume sole and complete responsibility for job site conditions during the course of construction of the project, including safety of all persons and property; that this requirement shall be made to apply continuously and not be limited to normal working hours; and the client further agrees to defend, indemnify and hold the engineer harmless from any and all liability, real or alleged, in connection with the performance of work on this project, excepting liability arising from the sole negligence of the engineer.

29. The client agrees to limit the engineer's liability to the client and to all contracters and subcontractors on the project, due to professional negligent acts, errors or omissions of the engineer to the sum of $50,000 or the engineer's fee, whichever is greater.

30. Upon written request, each of the parties hereto shall execute and deliver, or cause to be executed and delivered, such additional instruments and documents which may be necessary and proper to carry out the terms of this agreement.

31. The terms and provisions of this agreement shall not be construed to alter, waive, or affect any lien or stop notice rights, which the engineer may have for the performance of engineering services under this agreement.

32. One or more waivers of any term, condition or covenant by the engineer shall not be construed by the client as a waiver of a subsequent breach of the same or any other term, condition or covenant.

33. In the event client fails to pay engineer promptly or within sixty (60) days after invoices are rendered, then client agrees that engineer shall have the right to consider said default a total breach of this agreement and the duties of the engineer under this agreement terminated. In such event, client shall then promptly pay the engineer for all of the fees, charges and services performed by engineer on an agreed hourly basis.

34. In the event any provision of this agreement shall be held to be invalid and unenforceable, the other provisions of this agreement shall be valid and binding on the parties hereto.

35. Services provided within this agreement are for the exclusive use of the client.

36. There are no understandings or agreements except as herein expressly stated.

PROPOSED ESB OPERATION TO SIMULATE REGIONAL CONDITIONS FOR ODOR EVALUATION

An odor evaluation of the Emergency Storage Basin (ESB) Operation is proposed to be conducted concurrently with the expanded SSB odor studies. For this study, the earthen basin in the ESB would be diked off to create a pilot scale earthen basin, Figure 4-1. This earthen basin, plus the two paved cells are of a capacity such that the fill and draw rates of the Regional Plant can be simulated within the existing hydraulic capabilities of the Central Treatment Plant. In the 60-day period from June 15 to August 15, several ESB operation sequences can be simulated. Eutek, as described in Attachment 2, will monitor the odor emissions from all phases of this operation. The results of this study would be included and coordinated from the data collected in the SSB's study and reported in the revised "SSB Studies Development of Odor Criteria for Large Emission Areas".

SIMULATION OF SSB OPERATION

The Regional Plant will initially have an ADWF of 125 mgd. During critical river flow conditions, the treated effluent would be stored in the ESB. The length of time that storage would be required is influenced by river flow and tidal conditions. The analysis recently developed in the "Report on Partial Pavement Failure of the Emergency Storage Basin (February 1978)" concluded that on a long-term annual basis critical flow conditions, which would require effluent storage, would occur 33 times per year. During periods of extremely low river flow that occurred in 1976 and 1977, effluent would have been diverted to the ESB for 119 days in 1976 and 319 days in 1977. Within this range, there will be an almost infinite number of fill and draw sequences that may occur.

During the 60-day odor evaluation period, essentially two different ESB operating modes would be simulated. The fill and empty schedule presented in Table 4-1 would simulate the ESB operation that would have been required in June and July 1977. Figure 4-2, from the February 1978 ESB Report, shows the hours of storage required on each high tide and Figure 4-3, from the same report, shows the resultant accumulation of stored effluent at various return rates. The operating sequence, based on the 52 mgd return rate, would be simulated in the ESB study.

In the first half of the ESB study, the basin would be filled with 14 million gallons on one day and emptied in the next. This process would be repeated five times. During this period, the amount of suspended solids deposition could be measured, and the odor impact of solids accumulation in the paved basins measured. During this period, the effect of various chlorine doses on algal growth could also be evaluated.

Following this initial study, 31 days of continuous ESB operation would be simulated. The ESB would be filled and partially emptied so that by the 15th day it would have simulated the accumulation of 110 million gallons in the full-scale ESB. In the last 16 days, the basin would be emptied. The ESB would be emptied by removing more water each day than is added until the basin is empty. During this period though, 172 million gallons would have been pumped in and out of the pilot ESB system which has a maximum storage capacity of 21 million gallons.

The last 10 days of the study have been left open for simulation of any special problems observed in the preceding 60 days.

TABLE 4-1

ESB OPERATION SIMULATION

Day	Fill	Empty	Cumulate	Day	Fill	Empty	Cumulate
1	14	0	14	31	1	2	19
2	0	14	0	32	2	3	18
3	14	0	14	33	3	4	17
4	0	14	0	34	4	5	16
5	14	0	14	35	5	6	15
6	0	14	0	36	6	7	14
7	14	0	14	37	7	8	13
8	0	14	0	38	7	8	12
9	14	0	14	39	7	8	11
10	0	14	0	40	7	8	10
11	0	0	0	41	7	8	9
12	0	0	0	42	7	8	8
13	0	0	0	43	6	5	9
14	9	5	4	44	0	5	0
15	9	6	7	45	0	0	0
16	9	8	8	46	0	0	0
17	8	7	9	47	0	0	0
18	8	7	10	48	0	0	0
19	8	7	11	49	0	0	0
20	8	7	12	50	0	0	0
21	8	7	13	51			
22	8	7	14	52			
23	7	6	15	53			
24	6	5	16	54			
25	5	4	17	55			
26	4	3	18	56			
27	3	2	19	57			
28	2	1	20	58			
29	1	0	21	59			
30	0	1	20	60			

Operation Description

Day 1-10 -- Measure accumulation of suspended solid in paved basins and determine the affect of varied chlorine dosage rates on algal growth.

Day 14-44 -- Simulate ESB operation that would have occurred in June-July 1977.

Day 11-13 -- Evaluate paved basin cleaning systems and measure odors.

Day 45-50 -- Drying period for earthen and paved basins.

Day 51-60 -- Optional period -- Design operation to simulate any special problems observed in preceding 50 days.

FIGURE 4-1
PILOT EARTHEN BASIN

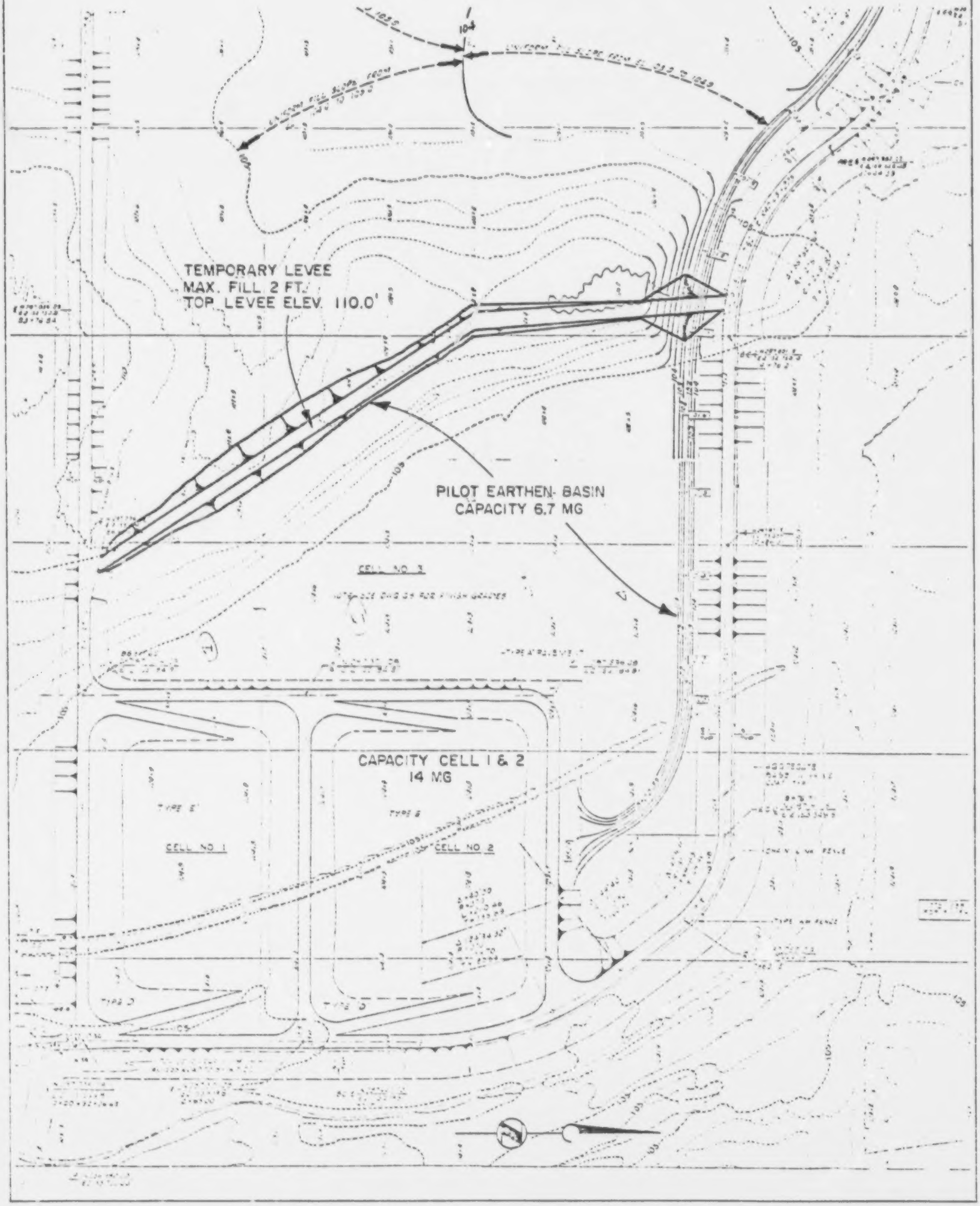


FIGURE 4-2
ESB STORAGE REQUIREMENTS FOR JUNE/JULY 1977

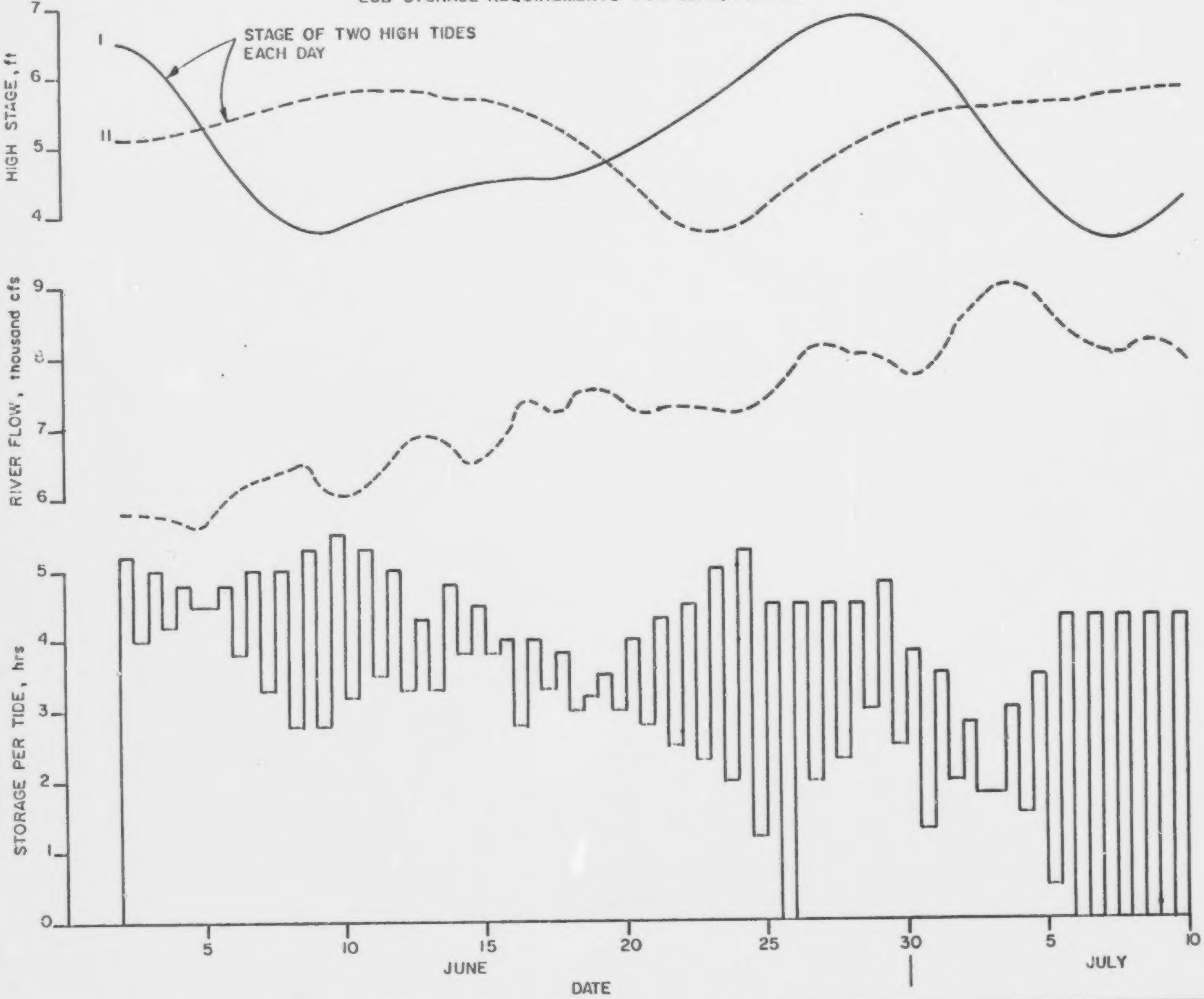
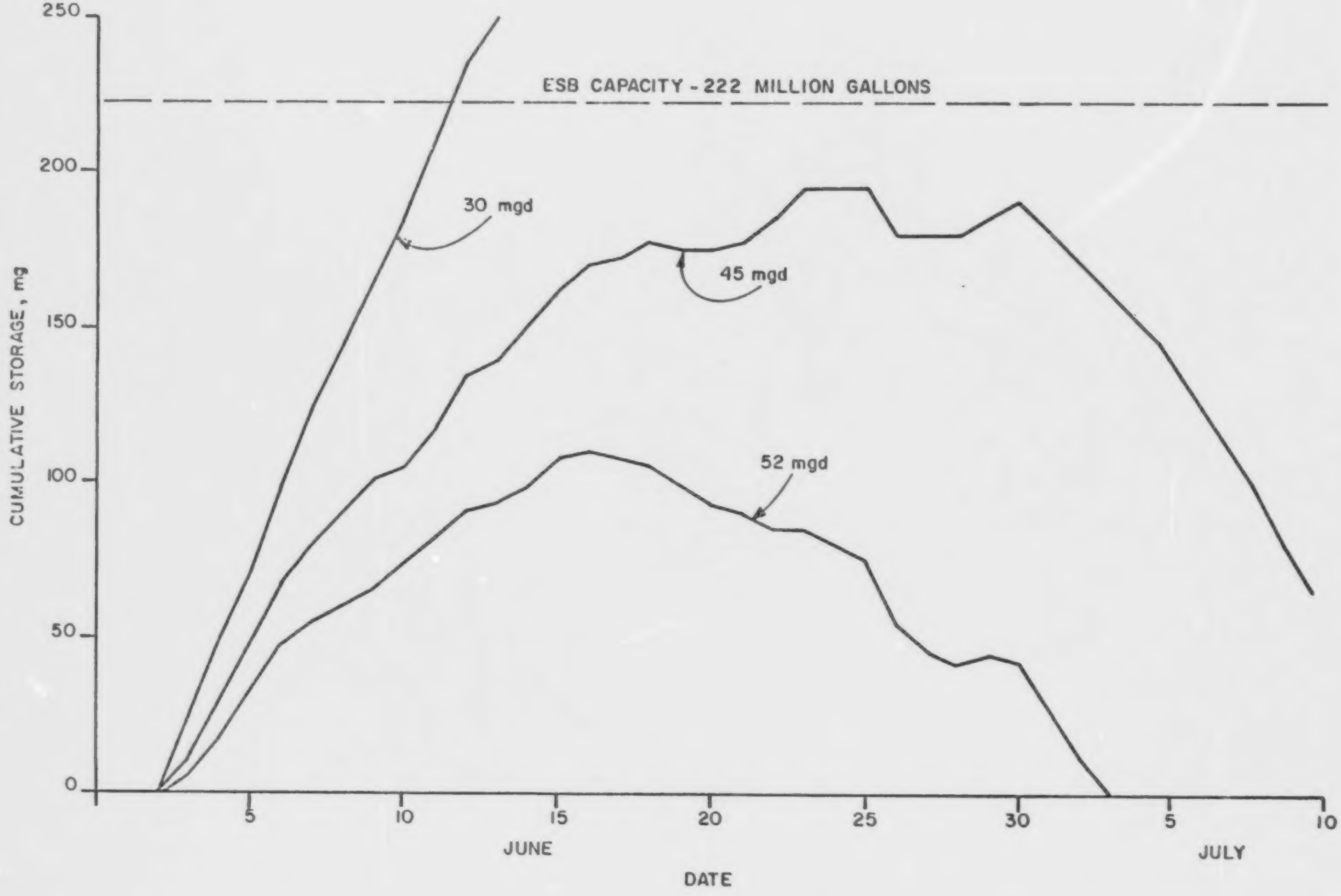


FIGURE 4-3
ESB CUMULATIVE STORAGE AT VARIOUS RETURN RATES FOR JUNE/JULY 1977



J365A
4.6.1-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.6.1 - SSB STUDIES DESIGN AND CONSTRUCTION OF INDUCED VERTICAL MIXING SYSTEMS

The design of Induced Vertical Mixing Systems for the SSB's or as they have now been called "SSB Barriers" was originally proposed as a task separate from the SSMP. Conversations with the State Water Resources Control Board have indicated that the design and construction of the inexpensive barriers would be fundable under the SSMP; therefore, the cost for design has been included as Subtask 4.6.1 of the SSMP.

Attached is the proposal dated February 6, 1978 for the Design of Induced Vertical Mixing Systems for SSB's. The design of the barriers is complete and a review draft of the contract documents has been delivered to the District for review. It is anticipated that the task will be completed within the proposed budget. The engineer's estimate for construction of the SSB Barriers is $365,000.

Program Costs

Design of Induced Vertical Mixing Systems for SSB's (see attached proposal)*	$ 57,000

Change in Subtask Costs

Estimated additional costs	$ 57,000

District Costs

SSB Barrier construction (engineer's est.)	$365,000
Wind machines (estimated cost)	45,000
Construction inspection	36,500
Total District costs	$446,500

*Manhour, other direct costs and subcontractor costs have been included in the SSMP Proposed Program Revisions, thus superseding the manhour and cost data originally submitted with the proposal for J365A.

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

February 6, 1978 J365

Mr. Brian H. Richter
Sacramento Regional County
  Sanitation District
827 Seventh Street
Sacramento, California 95814

PROPOSAL FOR DESIGN OF INDUCED VERTICAL MIXING SYSTEM FOR SSB'S

Submitted herewith is a proposal for conduct of the engineering work necessary for design of an Induced Vertical Mixing (IVM) system for the existing Solids Storage Basins (SSB's) at the Regional Treatment Plant. The system will consist of fixed barrier structures and mechanical wind machines (to be rented) to break up the laminar flow of odor-laden air over the SSB's during periods of unfavorable micrometeorology. The purpose of this system is to assess the ability of an IVM system to reduce the frequency of nuisance-level odors at the plant boundary.

As requested by your staff, the engineering work is to be done as a CPFF contract amendment. It includes the following phases:

- Development of IVM design criteria
- Preparation of drawings and specifications
- Review of construction

Monitoring of the results of operation of the IVM system will be done jointly by the District and SAC and its subcontractor. The monitoring work will be included in a revision of the Sewage Sludge Management Program (SSMP) work plan.

Total cost of the work included in this proposal is $56,372, of which $32,832 is for work by Eutek, Inc. as a subcontractor to SAC.

We estimate that the earliest date the IVM system can be in operation is August 15, 1978. To avoid further delay beyond this date, we recommend that you authorize commencement of this work immediately. We assume that the Administrative Services Division will coordinate the necessary contract amendment for formal approval of this work.

SACRAMENTO AREA CONSULTANTS

Lyle N. Hoag

Lyle N. Hoag
General Manager

LNH:dlb
Attachment

cc: W. S. Hyde
V. F. Scotti
W. N. Anderson
J. A. Spencer

PROPOSAL FOR

DESIGN OF INDUCED VERTICAL MIXING SYSTEM

FOR THE SOLIDS STORAGE BASINS

SACRAMENTO AREA CONSULTANTS

February 6, 1978

SECTION 1

SCOPE AND SCHEDULE OF SERVICES

This proposal is for the conduct of the engineering work necessary for design of an Induced Vertical Mixing (IVM) system for the existing Solids Storage Basins (SSB's) at the Regional Treatment Plant. The system will consist of fixed barrier structures and mechanical wind machines (to be rented) to break up the laminar flow of odor-laden air over the SSB's during periods of unfavorable micrometeorology, thus reducing the frequency of nuisance-level odors at the plant boundary. Monitoring of the results of operation of the IVM system will be done jointly by the District and SAC and its subcontractor. The monitoring work will be included in a revision of the Sewage Sludge Management Program (SSMP) work plan.

Scope of Work

The engineering work included in this proposal involves:

- Development of IVM design criteria
- Preparation of drawings and specifications
- Review of construction

Work Plan

For purposes of definition of scope and cost estimating, the engineering work has been broken down into Tasks and Subtasks as follows:

Task 1 - Project Management. Project Management will be the responsibility of Sacramento Area Consultants (SAC) with Warren R. Uhte as Project Manager. This function will continue throughout the period of the work and will involve:

- Project planning, coordination and budget control
- Management, coordination, and review of work by subconsultants
- Review of all project outputs
- Determination of grant eligibility of IVM System
- Conduct of meetings and other communications with District and others, such as grant eligibility reviewers
- Preparation of cost estimates

Task 2 - Development of IVM Design Criteria. This work will be conducted by Eutek, Inc. in accordance with its proposal included herein as Attachment A.

Task 2A. In this subtask, a plan of action for the development of criteria and completion of the IVM systems study will be formulated. Outside experts on micrometeorology and aerodynamics will be utilized in this effort. The plan of action will be reviewed prior to completion of the remaining tasks.

Task 2B. This second phase of work will include an office study of feasibility of IVM, flow visualization in a wind tunnel, and finally the development of criteria for the design of these systems. The outside consultants and wind tunnel will be utilized in this phase of work.

Task 2C. Results of the above phases of work will be summarized in a Design Criteria Report.

Task 3 - Preparation of Drawings and Specifications.

Task 3A. Preparation of drawings for fixed barrier system. A plan of the project area will be produced by aerial photogrammetry and will serve as the construction plan. Additional part plans, sections and structural details will require two or three drawings. The total number of sheets will be four or five.

Task 3B. Preparation of specifications for the fixed barrier system. If grant eligibility is expected, the specifications will meet grant program requirements.

Task 3C. Preparation of specification for rental of mechanical wind machines. Simple technical specifications will be provided for use by the District.

Task 4 - Services During Construction. Services during construction will be provided, including:

- Answering bidders' inquiries and preparation of addenda
- Review of Contractor's submittals
- Periodic visits to site (approximately four visits) with, and as requested by, the Resident Engineer, plus a final inspection of the work with the Resident Engineer

Project Schedule

Assuming that approval to proceed with this work is given by February 10, 1978, and the work can proceed without unexpected delays or complications, the following schedule can be met:

Task or Event	Beginning Date	Completion Date
Task 1. Project Management	February 10	August 15
Task 2. Development of IVM System Design Criteria		
Task 2A	February 10	February 20
Task 2B	February 20	March 20
Task 2C	March 20	April 5
Task 3. Preparation of Drawings and Specifications		
Task 3A	March 20	April 15
Task 3B	March 20	April 15
Task 3C	March 20	April 20
Task 4. Construction		
Engineering Services	April 30	August 15
Construction of barrier system:		
Advertise for bids		April 30
Accept bids		May 15
Construction	June 15	August 15
Procurement of wind machines	April 30	August 15

ATTACHMENT A

PROPOSAL OF EUTEK, INC.
FOR
TASK 2 FOR DESIGN OF INDUCED VERTICAL MIXING SYSTEM
FOR THE SSB'S

EUTEK INC.
process
development
and
engineering
1828 TRIBUTE ROAD, SUITE H SACRAMENTO, CA 95815 (916) 929-2003

January 23, 1978

Mr. Warren Uhte
Sacramento Area Consultants
723 "S" Street
Sacramento, CA 95814

RE: PLAN OF ACTION
INDUCED VERTICAL MIXING (IVM)

Dear Warren:

Discussions were pursued during the past week with a number of experts who have worked with stable sublayer conditions. The objectives of these discussions were to determine experience relevant to the problem at hand, the feasibility of simulating conditions in a wind tunnel, and, a reasonable scope of study that might be accomplished within the rather limited time available. Individuals contacted were Messrs. Stafford of Tropic Breeze Wind Machines, Chalker of Dupont, Schwegmann of Kaiser, and, Cermak of Colorado State University at Fort Collins. None of these individuals could impart a great deal of additional information on stable sublayer phenomenon beyond that which we have already obtained. Almost all expressed doubt as to the feasibility of mechanically inducing vertical mixing even though our limited data would suggest that this is possible. A micrometeorological wind tunnel is available at Colorado State University. however, the scope of work that could be accomplished there would have to be limited to flow visualization studies. Prior to such studies, it would be necessary for us to define the relevant ranges of similitude parameters and the appropriate flow visualization observations required to develop the design criteria.

The time demands of the above experts are very great and in all cases expressed a preference of avoiding travel to and from Sacramento if possible. It would be our recommendation that we proceed to assemble the relevant micrometeorological data and topographic information to be forwarded as soon as possible to Dr. Cermak for his review and recommendations for flow visualization study. The objective of this initial phase would be to conduct a preliminary paper

RECEIVED
JAN 25 1978
WARREN UHTE'S OFFICE

study of alternative IVM systems in order to identify the best candidate designs for visualization.

Please advise if you would like me to proceed with this work.

Very truly yours,

EUTEK, INC.

George E. Wilson

GEW/lkb

cc: Terry W. Schroepfer

EUTEK INC.
process
development
and
engineering
1828 TRIBUTE ROAD, SUITE H SACRAMENTO, CA 95815 (916) 929-2003

PROPOSED WORK FOR 1978

INDUCED VERTICAL MIXING SYSTEMS (IVM)
SACRAMENTO SEWAGE SLUDGE MANAGEMENT PROGRAM

Prepared For:

Sacramento Area Consultants
Sacramento, California

January 24, 1978

77-12-01

LIST OF EXHIBITS

Exhibit	Description
A	EPA Form 5700-41
B	Hourly Rate Schedule
C	Hourly Rate Adjustment
D	Summary Task Description
E	Summary of Projected Indirect Costs
F	Indirect Cost Accumulations
G	Summary of Other Direct Costs

EXHIBIT A

EPA FORM 5700-41

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS
(See accompanying instructions before completing this form.)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE Sacramento Regional County Sanitation District	2. GRANT NUMBER
3. NAME OF CONTRACTOR OR SUBCONTRACTOR EUTEK, INC.	4. DATE OF PROPOSAL January 24, 1978
5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)* 1828 Tribute Road, Suite H Sacramento, CA 95815	6. TYPE OF SERVICE TO BE FURNISHED SAC Odor Studies Induced Vertical Mixing

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Principal Engineer	44	$ 30.35	$ 1,335.40	
Staff Engineer	152	11.56	1,757.12	
Engineer	220	7.33	1,612.60	
Technician/Draftsman	40	7.00	280.00	
Clerical	56	5.27	295.12	
DIRECT LABOR TOTAL:				$ 5,280.24
8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	
See Exhibit E	1.89	$ 5,280.24	$ 9,979.65	
INDIRECT COSTS TOTAL:				$ 9,979.65
9. OTHER DIRECT COSTS				
a. TRAVEL			ESTIMATED COST	
(1) TRANSPORTATION			$ 2,000.00	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$ 2,000.00	
b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	
Wind Tunnel		$ 2,500.00	$ 2,500.00	
Report Costs		325.00	325.00	
EQUIPMENT SUBTOTAL:			2,825.00	
c. SUBCONTRACTS			ESTIMATED COST	
Outside Consultants			$ 10,000.00	
SUBCONTRACTS SUBTOTAL:			$ 10,000.00	
d. OTHER *(Specify categories)*			ESTIMATED COST	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 14,825.00
10. TOTAL ESTIMATED COST				$ 30,084.89
11. PROFIT	18% of Direct/Indirect Costs			$ 2,746.78
12. TOTAL PRICE				$ 32,831.67

EPA Form 5700-41 (2-76)

PAGE 1 OF 5

EXHIBIT A

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES (*Indicate basis for price comparison*)	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☒ YES ☐ NO *(If "Yes" give name address and telephone number of reviewing office)*

Environmental Protection Agency Auditors
100 California Street
San Francisco, CA 94111 415-556-1954

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

See Exhibit F

14c.

This proposal is submitted for use in connection with and in response to *(1)* SAC Request . This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* January 24, 1978 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) January 24, 1978
DATE OF EXECUTION

E. Wilson
SIGNATURE OF PROPOSER

President
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

EXHIBIT B

HOURLY RATE SCHEDULE

EXHIBIT B

HOURLY RATE SCHEDULE

CLASSIFICATION	DIRECT/INDIRECT COST CHARGE	GROSS PROFIT CHARGE (18%)	CHARGE RATE PER HOUR
Principal Engineer	$ 46.61	$ 8.39	$ 55.00
Senior Engineer	38.14	6.86	45.00
Staff Engineer	33.90	6.10	40.00
Supervisor	29.66	5.34	35.00
Technician/Draftsman	22.88	4.12	27.00
Assistant Technician	15.25	2.75	18.00
Clerical	15.25	2.75	18.00

EXHIBIT C

HOURLY RATE SCHEDULE ADJUSTMENT

EXHIBIT C

HOURLY RATE SCHEDULE ADJUSTMENT

CLASSIFICATION	TOTAL NUMBER OF HOURS	PRESENT CHARGE RATE PER HOUR	TOTAL
Principal Engineer	44	$ 55.00	$ 2,420.00
Staff Engineer	152	40.00	6,080.00
Engineer	220	33.00	7,260.00
Technician/Draftsman	40	27.00	1,080.00
Clerical	56	18.00	1,008.00
TOTAL			$17,848.00

Total Direct/Indirect Plus Profit = $18,006.67

EXHIBIT D

SUMMARY TASK DESCRIPTION

EXHIBIT D

SUMMARY TASK DESCRIPTION

INDUCED VERTICAL MIXING SYSTEMS (IVM)

OBJECTIVES

The objective of this phase of work is to develop design criteria for an induced vertical mixing system to provide maximum initial dispersion of odor emissions from SSBs under both low ambient wind velocities and high ambient wind velocities. The initial task would be to develop rational design criteria for both wind machines for operation under low ambient wind velocity conditions and for stationary barriers which would be designed to take advantage of energy contained in convective winds to provide maximum initial dispersion of odors from the SSBs.

WORK PLAN

Phase A

In the first phase a plan of action for the development of criteria and completion of the IVM systems study will be formulated. Outside experts on micrometeorology and aerodynamics will be utilized in this effort. Once the plan of action has been developed, the plan will be reviewed prior to completion of the remaining tasks.

Phase B

This second phase of work will include a paper study of feasibility of IVM, flow visualization in a wind tunnel, and finally the development of criteria for the design of these systems. The outside consultants and wind tunnel will be utilized in this phase of work.

Phase C

Results of the above phases of work will be summarized in an Interim Report.

SCHEDULE

A tentative schedule is presented on the attached Table D-1.

ESTIMATED COST

Estimated costs and man-hour requirments are included on Tables D-2 and D-3.

CRITICAL TIME ITEMS

The wind tunnel availability is extremely limited as is the time of the proposed consultants. This work can be best expedited with advance scheduling. It will be necessary to initiate the initial design investigation on this task as early as possible in 1978 in order that the induced vertical mixing systems will be operational by the first of September, 1978.

TABLE D-1

TENTATIVE TIME SCHEDULE

Task/Phase	Time, 1978			
	Jan	Feb	Mar	Apr
I. INDUCED VERTICAL MIXING SYSTEM				
A. Plan of Action		Δ—Δ		
1. Consultation				
B. Design Criteria Study				
1. Consultation		Δ—Δ		
2. Paper Study		Δ—Δ		
3. Flow Visualization		Δ—Δ		
4. Develop Criteria			Δ—Δ	
C. Interim Report			Δ—Δ	

TABLE D-2

SUMMARY OF ESTIMATED COSTS ($)

Phase	Materials	Travel	Equipment	O/S Consultants	Services	Total
II-A		500		2,000	1,936	4,436
II-B		1,500	2,500	8,000	11,244	23,244
II-C	325				4,668	4,993
TOTALS	325	2,000	2,500	10,000	17,848	32,673

TABLE D-3

MAN-DAY REQUIREMENTS BY PHASE

Classification	II-A	II-B	II-C	Man-Days All Phases	Total Hours	Direct $/Hour	Direct Salary Totals
Principal Engineer	2	2	1.5	5.5	44	30.35	$ 1,335.40
Staff Engineer		13	6	19	152	11.56	1,757.12
Engineer	4	23.5		27.5	220	7.33	1,612.60
Tech./Draftsman			5	5	40	7.00	280.00
Clerical			7	7	56	5.27	295.12
TOTALS	6	38.5	19.5	64	512		$ 5,280.24
Other Direct Costs *							
Outside Consultants	2,000	8,000					$10,000.00
Equipment		2,500					2,500.00
Report Costs			325				325.00
Travel	500	1,500					2,000.00
TOTALS	2,500	12,000	325				$14,825.00

*See Exhibit G

EXHIBIT E

SUMMARY OF PROJECTED INDIRECT COSTS

EXHIBIT E

SUMMARY OF PROJECTED INDIRECT COSTS

CATEGORY	TOTAL % OF DIRECT LABOR
SALARY OVERHEAD	
Indirect Salaries	58.69
Employer Payroll Taxes	7.59
10% Pension Plan	13.24
Total Indirect Salary Expenses	79.52
GENERAL AND ADMINISTRATIVE OVERHEADS	
Dues	1.26
Group Medical Insurance	10.92
Business Liability Insurance	12.64
Legal & Accounting Expense	3.32
Licenses	.43
Pension Administration Expense	2.48
Postage	1.14
Professional Fees	2.26
Rent	9.56
Rental of Equipment	4.80
Maintenance	2.28
Property Taxes	1.44
Telephone	3.40
Utilities	1.11
Auto Expense	8.82
Conventions & Seminars	2.04
Engineering Supplies	6.87
Experimental Expense	7.90
Freight	.54
Laboratory Expense	8.55
Office Expense	7.90
Subscriptions	2.65
Travel Expense	7.32
Total General and Administrative Expenses	109.63
TOTAL ALLOWABLE OVERHEAD	189.15%
UNALLOWABLE EXPENSES	
Contributions	.22
Entertainment	1.80
Interest	1.55
Promotion	6.42
TOTAL UNALLOWABLE OVERHEAD	9.99%

EXHIBIT F

INDIRECT COST ACCUMULATIONS

EXHIBIT F

INDIRECT COST ACCUMULATIONS

Proposed indirect costs are 79.52 percent of direct labor for salary overheads and 109.63 percent of direct labor for general and administrative overheads after deduction of unallowable costs. These have been computed as follows:

	PERCENT OF DIRECT LABOR			
	Actual	Unallowable	Adjusted	Proposed
Salary Overheads	79.52	--	79.52	79.52
General & Administrative Overheads	119.62	9.99	109.63	109.48
TOTAL	199.14	9.99	189.15	189.00

The proposed rate is for the year 1978 beginning January 1, 1978. The per diem rate has been computed in accordance with applicable regulations. It is this firm's policy to accumulate indirect costs in accordance with generally accepted accounting principles and applicable federal regulations. Indirect costs are accumulated in a manner allowing identification of salary overheads and general and administrative overheads.

Principal's salaries are treated in the same manner as other employee salaries. Direct principal labor to a project is charged to that project. All other principal time is accumulated in allowable indirect costs. The hourly charge rate is computed in the same manner for all employees in accordance with the published hourly charge rate sheet.

EXHIBIT G

SUMMARY OF OTHER DIRECT COSTS

EXHIBIT G

SUMMARY OF OTHER DIRECT COSTS

Phase		Estimated Cost
II-A	Outside Consultant Services	$ 2,000
	Travel Expenses	500
II-B	Outside Consultant Services	8,000
	Wind Tunnel	2,500
	Travel Expenses	1,500
II-C	Report Costs	325
	TOTAL ESTIMATED OTHER DIRECT COSTS	$ 14,825

J231N
4.8-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 4.8 - SSB STUDIES
SOLIDS STORAGE BASIN STUDY MANAGEMENT
DATA REDUCTION AND REPORT PREPARATION

Revisions to the 1978 work for this subtask includes overall management of the supplemental work on Subtask 4.1, SSB Operation and Performance Evaluation Program; Subtask 4.3, SSB Groundwater Monitoring and Site Engineering Work; and Subtask 4.6, SSB Development of Odor Criteria for Large Emission Areas.

The February 9, 1978 Recommended Program Revisions had an estimated cost of $10,000 to complete this subtask. The cost estimate for completion of this subtask has been increased to $18,940. This cost increase is due to the increased scope of Subtasks 4.1 and 4.6 which are managed under this subtask. In addition, this task in 1978 will also involve the completion of the final report on SSB Studies, which will summarize two annual reports and include results of the 1978 surface mixer studies and the final odor occurrence risk analysis.

Program Costs

Management of 1978 work	$ 9,800
Finalizing SSB Studies report	6,950
Report printing	1,605
Transportation	205
Toll calls	130
Expendable supplies	250
	$18,940

Change in Subtask Cost

Estimated additional costs	$18,940

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 5.1
DEDICATED LAND DISPOSAL STUDY
MANAGEMENT AND REPORT

The discussion of the work to be completed under Subtask 5.1 presented herein supersedes and revises the discussion presented in the February 9, 1978 Recommended Program Revisions.

The February 9, 1978 Recommended Program Revisions included an estimated cost for preparation of specifications and management of procurement of equipment for the 1978 Dedicated Land Disposal (DLD) operations. These estimated additional costs were $8,000. The actual cost incurred to date and estimated cost for supervision of Sludge Delivery System installation are $30,340. The following paragraphs describe the work that has been completed or required for coordination and management of installation of the Sludge Delivery System, Dredge, Booster Pump and Injector.

To assure the District's continued capability to efficiently spread sludge from the SSB's on the existing DLD site through the 1980's, it is necessary to replace the existing dredge with new equipment better suited to the removal of more concentrated sludge, to provide a booster pump for the dredge discharge pipeline, and to provide permanent direct injection equipment. The capital costs for this equipment are to be paid through the Sewage Sludge Management Program under the assumption that said costs will be grant-eligible if the SSMP-EIR process confirms the liquid state processing and disposal system for the Regional Plant. SAC has been asked to prepare the final specifications for this equipment to assure its compliance with the SWRCB regulations for grant eligibility.

In addition to the preparation of the specifications for these major equipment items, SAC has also been asked to lay out and supervise the installation of the dredge discharge pipeline and to formulate the specifications to be used for the leasing, by the District, of the tillage tractor and ancillary equipment for the 1978 surface spreading tests. The tillage tractor and ancillary equipment is part of the special DLD application techniques and, therefore, was not initially included in the subtask costs. It is expected that the work involved in the preparation of the above material will include meeting with members of the SWRCB staff to ascertain the unique requirements for the prepurchase funding commitments and the application of technical expertise to the preparation of detailed specifications and drawings that will achieve the desired performance results, i.e., discharge of at least 700 gpm of 6 to 8 percent harvested SSB sludge 6 to 8 inches below the surface of the ground at the existing 20-acre DLD site.

Purchase orders for the purchase of the subsurface injector and booster pump assembly system were issued April 17, 1978. A purchase order for the Dredge was issued April 19, 1978. A construction contract (Sludge Delivery System Contract No. 1170) for installation of the pipeline and booster pump was awarded on May 8, 1977. Communications with the vendors for the dredge, booster pump, and subsurface injector indicate that all will make their prescribed delivery dates.

Program Costs

Program Management	$ 1,000
Preparation of Specifications for sludge disposal and tillage equipment	10,000
Preparation of plans and specifications for Sludge Delivery System	12,360
Construction coordination	5,000
Reproduction	1,660
Travel	320
Total Estimated Cost	$30,340

Change in Subtask Cost

Estimated additional costs	$30,340

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 5.2 - DEDICATED LAND DISPOSAL STUDY, SITE DEVELOPMENT AND SLUDGE SPREADING

The discussion of the work to be completed under Subtask 4.1 presented herein supersedes and revises the discussion presented in the February 9, 1978 Recommended Program Revisions. The revisions presented herein include the transferring of the costs for the purchase of the dredge, subsurface injector, booster pump, and lease of the tillage tractor to a District cost under Subtask 5.2 of the SSMP.

The $30,000 budgeted by Dwight C. Baier for a tractor for the 1978 DLD operations, as documented in the December 10, 1976 SSMP proposal, has been deleted from Baier Agronomy's budget to help offset new costs for purchase of sludge disposal equipment.

In addition to this SSMP budget revision, two procedural revisions have been made to the sludge spreading program. The first involves the use of both the direct injection and tillage equipment, and the second involves the use of District personnel to operate the direct injection equipment. The extra costs expected to be incurred with the operation of two sets of spreading equipment has been completely offset by the District's request to use Central Treatment Plant personnel on the direct injection equipment. The use of District personnel will provide training for the continuing land spreading operation which, even if the SSB's provide only interim processing and storage, is expected to last well into the 1980's.

Program Costs

Estimated savings in cost	$ 30,000

Change in Subtask Cost

Estimated savings in cost	$ 30,000

District Costs

Sludge disposal equipment purchase	
Dredge	$120,021
Booster pump	20,183
Subsurface injector	95,920
Sludge Delivery System (Contract #1170)	53,893
Tillage tractor lease (estimate)	22,500
Sludge Delivery System construction inspection (Contract #1170)	5,400
Total District costs	$317,916

J231S
5.3-1
May 30, 1978

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 5.3 DEDICATED LAND DISPOSAL STUDY - SLUDGE AND DISPOSAL SITE MONITORING

The discussion of the monitoring work to be completed under Subtask 5.3 presented herein supersedes and revises the discussion presented in the February 9, 1978 Recommended Program Revisions. The revision presented herein includes the addition of six soil samples in lieu of a 50 percent reduction in soil samples, and the development of a long term DLD monitoring program.

The net cost change is a $37,560 cost savings instead of the $53,000 cost savings presented in the February 9, 1978 Recommended Program Revisions for the 50 percent reduction in soil samples.

The letter report from Dwight C. Baier, attached herewith, discusses the 1978 monitoring program and the schedule, such that the monitoring data will be included in the SSMP-EIR. It is necessary to increase the number of soil samples from 24 to 30 due to the releveling of the DLD after the 1976 spreading season and since the depth of incorporation during the 1977 studies was deeper than expected. As documented in Dwight C. Baier's report, sludge has been buried to an effective depth of 15 inches as a result of the releveling, therefore, it is necessary to analyze all the samples from the 18 inch to 30 inch depth to determine if there has been any leaching. At 50 percent of the sites the entire profile (each profile includes

The February 9, 1978 Recommended Program Revisions also called for transferring the 1979 DLD site monitoring to the District. The monitoring program that SAC and Baier Agronomy have conducted in the DLD for the past three years was designed for study purposes and not as a long-term DLD monitoring system. It is, therefore, recommended that SAC develop a long-term monitoring program for the DLD. The development of this monitoring program would include coordination with the Central Valley Regional Water Quality Control Board to determine their monitoring requirements. The program would also recommend sample collection and analytical procedures. The total cost for this would be $7,055.

The EPA Office of Solid Waste Management has issued testing procedures for substances that might be regulated under the Toxic Substances Control Act. The extraction methods differ from those used in the analysis of SSB sludges. Therefore, it is proposed that parallel analysis of the same sludge sample be done to compare the effect of the different extraction techniques on the results. The estimated cost for this work is $750.

Program Costs

Cost Savings	
50 percent reduction of 1978 harvested sludge samples	$ 1,600
Transfer of six months of 1978 Morrison Creek monitoring to District operations	10,800
Transfer of 1979 DLD site monitoring to District operations	33,500
Subtotal Cost Savings	$45,900
Additional Costs	
Analysis of 6 additional soil samples	1,285
Development of long-term DLD monitoring program (labor)	4,500
Baier Agronomy Inc.	2,020
Reproduction, expendable supplies	535
Subtotal, Additional Costs	$ 8,340
Total Cost Savings	$37,560

Change in Subtask Cost

Estimated Savings in Cost	$37,560

Baier Agronomy, Inc.
ROUTE 2 • BOX 605 • WOODLAND, CALIFORNIA 95695 • PHONE (916) 662-6516

PLANS FOR 1978 LABORATORY ANALYSES

OBJECTIVES

The DLD monitoring plan is designed to evaluate the environmental impact of sludge disposal. The phases of the environment at risk are the DLD soil, runoff water, and groundwater. The possible contaminants include:

1. Major ions such as the sulfates, chlorides, nitrates and bicarbonates of sodium, calcium and magnesium.
2. Heavy metals such as cadmium, copper, nickel and zinc.
3. Chlorinated hydrocarbons such as pesticides and polychlorinated biphenlys.
4. Bacteria
5. Sediments

This project was originally planned to extend through June 30, 1977, which would allow for evaluation of the 1978 spreading operations. The findings of the monitoring program naturally lag behind the spreading operations. For example, the soils are now being sampled to determine the effects of the 1977 spreading operation. Unfortunately, the EIR must be started in late 1978, making the inclusion of 1978 data impractical.

This paper will report the status of the 1977-78 analyses and describe the plans for their completion.

HEAVY METALS

It is believed that the heavy metals from the sludge will have been fixed in the soil near the zone of incorporation (less than 9" deep). The main objective of the 1978 monitoring is to verify this belief. If no heavy metals are found below the zone of incorporation, it will be assumed that they are fixed in the zone of incorporation in an immobile form.

As a pragmatic matter, the depth of the zone of incorporation varies from place to place in the DLD because in the spring of 1977, after the sludge spreading of 1976, it was necessary to re-level the DLD. The re-levelling process involved scalping the sludge-laden soil from the north end of the field and depositing it on top of sludge-laden soil in the south end. This made the sludge-soil mixture deeper at the south end and shallower at the north end. The work that was done is recorded on a surveyors map and it is now possible to determine the depth of the slduge-soil mix (effective depth) at the various soil sampling stations. The soil sampling stations are located on the DLD map in figure 1. Assuming the original depth of incorporation to be not more than .75 foot, the depth to which sludge may be now found (effective depth) is shown in tabular form in table 1.

TABLE 1

Station #	Depth of Cut (feet)	Fill (feet)	Effective Depth of Incorporation (feet)
1		.5	1.25
2		.5	1.25
3		.3	1.05

(table 1 continued)

Station #	Depth of Cut (feet)	Fill (feet)	Effective Depth of Incorporation (feet)
4		.5	1.25
5		.1	.85
6	.1		.75*
7	.3		.75*
8	0	0	.75*
9	.4		.75*
10	.6		.75*
11	.6		.75*
12	.7		.75*

*In 1977, after levelling had been completed, a second application of sludge was made, so the effective depth in the cut areas is assumed to be .75 feet.

Soil samples are collected from 0 - 6", 6" - 18", 18" - 30", and 30" - 42". If the heavy metals are immobile, no increase over background concentrations should be found in the 18" - 30" sample, even in the areas of maximum fill. It is therefore recommended that all 12 of the 18" - 30" segments be analyzed for heavy metals and that all four segments from stations 1, 3, 6, 7, 9 and 11 be analyzed for heavy metals.

MAJOR IONS (Salinity)

The segments of the environment to be protected from salinity are the groundwater and the runoff water. To the extent that the major ions are conservative (non-degradable) they will accumulate in the vadose zone. This accumulation will be covered in another report. Samples of 1977-78 runoff water have been analyzed for major ions. To evaluate the potential impact of major ions on groundwater, two sampling techniques are employed at this time, soil solutions and monitoring wells. The latter of these cannot be expected to reflect the effect of 1977 or 1978 sludge spreading because of the slow migration through the soil profile of even the most mobile constituents. The value of monitoring wells, therefore, is limited to establishing background concentrations. In deference to the regulatory agencies, it is recommended that the ten usable wells be analyzed (two have been destroyed).

The best method of evaluating the fate of major ions in the soil is by analyzing the soil solution. Samples are extracted in the field by using porous ceramic probes to which a high vacuum is applied. These samples have been collected from the zone of incorporation. A few have been obtained form deeper depths, but the soil was not always wet enough at the deeper depths to make collections of soil solutions possible. They were collected following each storm in 1977-78, and are now being analyzed for the major ions. They are worthless for the evaluation of heavy metals and chlorinated hydrocarbons because of the immobility of such constituents.

The third phase of the salinity evaluation is the analysis of the soil samples for major ions. Such analysis is necessary because soil solutions in the deeper zones was not always available due to the slow (if any) leakage from the surface soil to the deeper zones. All 48 samples must be analyzed.

CHLORINATED HYDROCARBONS

For purposes of environmental monitoring, this vast classification falls into two logical categories. They are pesticides and polychlorinated biphenyls (PCBs). Both are immobile in the soil, are subject to biological degradation and both have a low water solubility and a high affinity for soil colloids. If follows, therefore, that if they are present, they will be found adsorbed to sediments, either in the soil or in runoff sediments.

Runoff has been analyzed in 1977-78 for chlorinated hydrocarbons with rather negative results. It is concluded that the concentrations are lower than the laboratory ability to detect. In any case, the runoff is returned to the central treatment plant, so it is recommended that the analyses for chlorinated hydrocarbons in runoff be discontinued.

Chlorinated hydrocarbons in the soil are expected to be fixed in the zone of incorporation and are not expected to move with the soil water. Much of the rationale used for heavy metals applies also to chlorinated hydrocarbons. It is recommended that the same sampling procedure be followed for chlorinated hydrocarbons as for heavy metals, viz. analyze the 18" - 30" segment from all twelve sampling stations and analyze all four segments from sampling stations 1, 3, 6, 7, 9 and 11.

BACTERIA

The only samples that are being analyzed for bacteria counts are the surface runoff samples. These analyses have all been done for 1977-78.

SEDIMENTS

The only samples that are being analyzed for sediments and turbidity are the runoff samples. These analyses have all been done for 1977-78.

TIMETABLE

In keeping with the original contract, the analytical work in connection with the monitoring program had been programmed to extend through most of the summer, so that the results would be available for the environmental impact report in October. It has now been proposed that the timetable be compressed and the results be available at an earlier date. In an effort to comply with this new timetable, the schedule has been revised to finish the analytical work by July 1 and to have the interpretation of the data available by August 15. It should be clearly understood that this schedule does not include any report writing. It is anticipated that an annual report of the 1978 operations due in January 1979 will include an analysis of the 1977-78 data and a final report, due June 30, 1979, will include all of the data and a complete interpretation, conclusions and recommendations.

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 6.1 - MISCELLANEOUS USE DETERMINATIONS - MICROBIOLOGICAL STUDIES

The February 9, 1978 Recommended Program Revisions had estimated a savings in cost of $40,000 for the early termination of the Microbiological Studies. The current estimate of final billings indicate that the ultimate savings will be $45,000.

Change in Subtask Cost

Estimated savings in cost	$45,000

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 6.7 - MISCELLANEOUS USE DETERMINATIONS - VIRUS STUDIES

The February 9, 1978 Recommended Program Revisions had estimated a savings in cost of $80,000 for the early termination of the Virus Studies. The current estimate of final billings indicate that the ultimate savings will be $95,000.

Change in Subtask Cost

Estimated savings in cost	$95,000

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 7.1 - SSB STUDIES ENVIRONMENTAL IMPACT REPORT

The discussion of the revisions to the SSB - EIR presented herein supersedes and revises the discussion presented in the February 9, 1978 Recommended Program Revisions. The revisions presented herein include the deletion of the $5,000 savings shown for the elimination of the separate DLD - EIR (J232B). This additional costs for special archaeological investigations; additional studies of attraction of birds to the SSB's; and coordination with regulatory agencies and the meeting of new "Notice of Preparation" requirements.

In accordance with District decisions on December 16, 1977, and January 5, 1978, the separate SSB and DLD EIR's have been combined into a single SSMP-EIR which, as indicated by the new completion schedule shown in Figure 7.1-1, is to be available for public distribution and hearings in the fall of 1978. Work on the separate SSB-EIR was close to 70 percent complete by the time the decision to combine had been made. By the end of December, 1977, slightly less than $77,000 of the $118,600 subtask budget had been spent. In addition, it is estimated the work involved in developing the interim alternatives and the new combined EIR work plan during the month of February has cost an additional $9,600, leaving $32,000 of the original subtask budget available for the SSMP-EIR.

Costs from February 1, 1978, for the combined SSMP-EIR are estimated to be as follows:

Labor Costs

Project management	$ 13,200
Revise Chapter 1, develop Chapter 2	2,900
Environmental setting	14,200[1]
Treatment and waste loads	5,000
Regulations	5,000[2]
Project alternatives	13,500
Alternative evaluation	16,700
Odor consideration	4,600
Rating of projects	2,000
Conclusions	2,000
Preliminary draft EIR	8,300
Draft EIR	14,000
Draft EIR review	7,300
Preliminary final EIR	10,000
Final EIR	3,100
Total Labor Costs	$121,800

[1] Additional $4,000 added since 2/9/78 proposal.
[2] Additional $1,000 added since 2/9/78 proposal.

Direct Expenses

Reproduction	$ 13,000
Travel	1,600
Subsistence	400
Communication	200
Total Direct Costs	$ 15,200
Total Costs Subtask 7.1	$137,000

Change in Subtask Cost

Total cost revised subtask 7.1	$137,000
Monies left over from SSB EIR	32,000
Estimated additional costs	$105,000

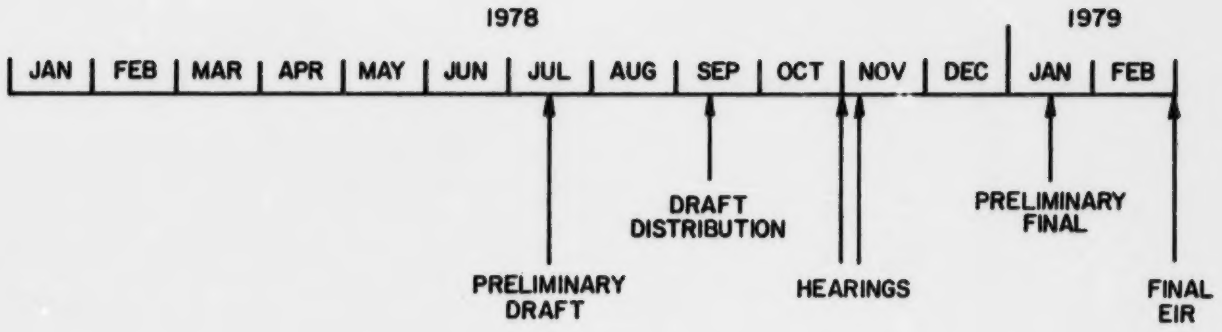


Fig. 7-1 Revised SSMP EIR Schedule

SEWAGE SLUDGE MANAGEMENT PROGRAM

RECOMMENDED REVISION - SUBTASK 7.2 - DEDICATED LAND DISPOSAL - ENVIRONMENTAL IMPACT REPORT

In accordance with District decisions on December 16, 1977, and January 5, 1978, the separate SSB and DLD-EIR's have been combined into a single SSMP-EIR. As a consequence of this action, work on the DLD-EIR was stopped and all material and manpower efforts transferred to the preparation of a combined EIR work plan. By the end of December 1977, almost $4,000 of the $109,600 subtask budget had been spent. It is not expected that over $600 was spent in January 1978, closing up the work, leaving a savings of $105,000, which can be used to cover the additional cost of the combined SSMP-EIR, subtask 7.1.

Change in Subtask Cost

Estimated savings in costs	$105,000

SECTION 2

SEWAGE SLUDGE MANGEMENT PROGRAM
SUMMARY OF RECOMMENDED PROGRAM REVSIONS

25

SECTION 2

SUMMARY OF RECOMMENDED SUBTASK REVISIONS

The enclosed EPA Form 5700-41 presents the net increase in project cost for the Sewage Sludge Management Program. Included in this project cost is the estimated cost and profit for Scope Changes No. 4 and 5 which were approved by a Letter of Authorization dated September 20, 1977 and the Recommended Program Revisions which are detailed in Section 1 of this proposal. Tables 2-9, 2-10, and 2-11 provide a summary of the cost data for the Recommended Program Revisions. A portion of these new costs have been offset by cost reductions and scope reductions in the currently authorized Sewage Sludge Management Program.

In Table 2-1 the total project cost has been summarized by Task. Column 4 (Proposed Revisions, Detail) presents the detail of additions and deletions from each Task, while column 5 (Proposed Revisions, Net) presents the net change in each Task. Column 6 (Current Estimate) presents the current estimate for each Task which includes monies spent prior to November 1, 1976 under the interim SSMP Job Number J222A. Note that the amounts have been rounded so the total costs on Table 2-3 do not correspond precisely with the amounts on the Form 5700-41.

In Table 2-2 the total project cost has been summarized by Subtask with the same column headings as used in Table 2-1. The total of column 5 (Proposed Revisions, Net) provides the net increase in project cost to cover the recommended revisions presented in Section 1. This total includes additional profit on labor, other direct costs, and subcontractors. The following paragraphs describe the development of the revised program costs.

Project Cost and Profit Calculation

In Table 2-3 total project cost and profit are summarized exclusive of $411,000 authorized under the interim Job Number J222A. Item No. 1 summarizes the authorized estimated cost, profit, and total project cost under Amendment 10 and Amendment 10A. Item No. 2 and Item No. 5 have been added to the Program with a portion of the additional cost offset by scope and cost reductions summarized in Item 4.

Estimated Cost Column. Estimated cost for Item 1 comes from Amendment 10 and Amendment 10A. Estimated cost for Item 2 comes from the Letter of Authorization signed by the District on September 20, 1977. Estimated Cost of scope and cost reductions, Item 4, was determined by deducting SAC profit from the proposed scope reductions in work authorized under Amendments 10 and 10A. Estimated Cost of Proposed Program Revisions, Item 5 is as summarized on Tables 2-9, 2-10, and 2-11. Item 6, Estimated Revised Program Cost, is obtained by adding Item 2 and Item 5 to Item 1 and deducting Item 4.

Profit Column. Item 1 represents the profit approved under Amendments 10 and 10A divided into profit on: (1) SAC direct and other direct costs and (2) subcontractor costs. Item 2 presents the additional profit for Scope Changes No. 4 and 5.

Item 4 presents the profit deducted for scope reductions described in Section 1 from work authorized under Amendments 10 and 10A. Detailed breakdowns of the profit deductions are presented in Tables 2-4 for Task 5 and 2-6 for Task 6. Tables 2-5 and 2-7 present a summary of cost reductions for Tasks 5 and 6 respectively. Profit was not deducted from these amounts because there was not a reduction in scope of work. Profit was also not deducted for reduced subcontractor cost because the deductions did not reduce the total subcontractor cost below 20 percent of the estimated cost.

Profit on Proposed Program Revisions for SAC labor plus other direct costs is shown in Item 5. Details of these calculations are found on Tables 2-9 and 2-10.

Profit on subcontractors shown in Item 5 was calculated as follows: (Total Estimated Revised Program Cost, Item 6) times (0.20)(0.07) minus (Total Subcontractor Profit, Amendments 10 and 10A, Item 1) equals (Additional Subcontractor Profit, Item 5). This amount has been included in the Form 5700-41 profit amount. Profits on labor and other direct cost included in the Form 5700-41 are calculated by adding Item 2 and Item 5 less Item 4.

Total Project Cost Column. Total Project Cost is the sum of Estimated Cost plus Profit for each Item on Table 2-3. Total Project Cost included on Form 5700-41 as Total Price is the sum of Item 2 and Item 5 less Item 4.

Form 5700-41. The values for Total Estimated Cost, Profit and Total Price on the Form 5700-41 are additive to the corresponding totals for Amendments 10 and 10A. Table 2-8 documents the derivation of the values presented in the Form 5700-41. The profit value was computed as previously described.

Table 2-1. Project Cost Summary by Task
(dollars)

Task Number and Title	12/10/76 Authorized Estimate	1/1/78 Authorized Scope Changes	1/1/78 Authorized Estimate	5/30/78 Proposed Revisions		5/30/78 Current Estimate
				Detail	Net	
Task 1 Program Management	163,900	0	163,900 (100,970)[6]	3,000	3,000	166,900
Task 2 Regulatory Agency Coord.	11,700	0	11,700 (2,700)[6]	(2,500)[7]	(2,500)	9,200
Task 3 Source Survey	27,900	4,120[4]	32,020 (26,880)[6]	16,530	16,530	48,550
Task 4 Solid Storage Basin Study	606,000 (283,900)[1]	25,150[4],[5]	631,150 (603,150)[6]	552,800	552,800	1,183,950
Task 5 Dedicated Land Disposal Study	605,700 (97,900)[1]	5,200[4]	610,990 (313,080)[6]	38,680 (75,900)[7] (45,000)[8]	(82,220)	528,770
Task 6 Miscellaneous Use Determinations	189,600 (13,600)[1]	58,850[4]	248,450 (46,210)[6]	(140,000)[7] (25,000)[8]	(165,000)	83,450
Task 7 SSMP - EIR	228,280	0	228,200 (80,850)[6]	105,000 (105,000)[7]	0	228,200
TOTAL	1,833,080 (411,000)[1]	93,410	1,926,410 (1,173,840)[6]	716,010 (323,400)[7] (70,000)[8]	322,610	2,249,020

[1] Monies spent prior to 11/1/76, J222A
[2] Separate study costs, not included in SSMP budget
[3] Included in Subtask 1.1 costs
[4] Authorization executed 5/23/77
[5] Letter of Authorization, 9/20/77
[6] Monies spent as of 1/1/78
[7] Savings in 1978-79 budgeted costs
[8] Reallocated unspent 1976-77 funds

Table 2-2 Continued

Job Number (Subacc't)	Subtask Number and Title	12/10/76 Authorized Estimate	1/1/78 Authorized Scope Changes	1/1/78 Authorized Estimate	5/30/78 Proposed Revisions		5/30/78 Current Estimate
					Detail	Net	
	Task 4 - Solid Storage Basin Study						
J231H	Subtask 4.1 Operation and Performance Evaluation Program	41,700 (9,700)[1]	0	41,700 (42,700)[6]	16,470	16,470	58,170
J231J	Subtask 4.2 Experimental Work	58,100	0	58,100 (48,930)[6]	0	0	58,100
J231K	Subtask 4.3 Goundwater Monitoring and Site Engineering Work	32,500 (6,500)[1]	14,020[5]	46,520 (45,140)[6]	16,250	16,250	62,770
J215A	Subtask 4.4 Diurnal Odor Studies	0 (63,000)[2]	0	0	0	0	0
J231L	Subtask 4.5 Source Odor Control Study	274,200 (134,800)[1]	2,310[4] 8,820[5]	285,330 (274,860)[6]	0	0	285,330
J231M	Subtask 4.6 Development of Odor Criteria for Large Emission Areas	161,900 (59,200)[1]	0	161,900 (161,620)[6]	444,140	444,140	606,040
J365A	Subtask 4.6.1 SSB Studies, Design, and Construction of Induced Vertical Mixing Systems	0	0	0	57,000	57,000	57,000
J222A	Subtask 4.7 Covering Feasibility Study	0 (3,500)[3]	0	0	0	0	0

Table 2-2. Project Cost Summary
(dollars)

Job Number (Subacc't)	Subtask Number and Title	12/10/76 Authorized Estimate	1/1/78 Authorized Scope Changes	1/1/78 Authorized Estimate	5/30/78 Proposed Revisions		5/30/78 Current Estimate
					Detail	Net	
	Task 1 - Program Management						
J231A	Subtask 1.1 Authorization Preparation and 1975 Studies	78,400 (73,000)[1]	0	78,400 (76,520)[6]	0	0	78,400
J231B	Subtask 1.2 1976-79 Studies	60,300 (9,700)[1]	0	60,300 (24,450)[6]	3,000	3,000	63,300
J231C	Subtask 1.3 Final Report Preparation	25,200	0	25,200	0	0	25,200
	Task 2 - Regulatory Agency Coordination						
J231D	Subtask 2.1 Liaison and Special Reports	11,700	0	11,700 (2,700)[6]	(2,500)[7]	(2,500)	9,200
	Task 3 - Source Survey						
J231E	Subtask 3.1 Raw Sludge Studies	14,200	2,940[4]	17,140 (12,400)[6]	(4,740)[9]	0	12,400
J231F	Subtask 3.2 Influent/Effluent Studies	5,400	1,180[4]	6,580 (4,700)[6]	(1,880)[9]	0	4,700
J231G	Subtask 3.3 Preparation of Progress Reports	8,300	0	8,300 (9,780)[6]	23,150	16,530	31,450

Table 2-2 Continued

Job Number (Subacc't)	Subtask Number and Title	12/10/76 Authorized Estimate	1/1/78 Authorized Scope Changes	1/1/78 Authorized Estimate	5/30/78 Proposed Revisions		5/30/78 Current Estimate
					Detail	Net	
J231N	Subtask 4.8 Study Management, Data Reproduction, and Report	37,600 (7,200)[1]	0	37,600 (29,900)[6]	18,940	18,940	56,540
	Task 5 - Dedicated Land Disposal Study						
J231P	Subtask 5.1 Management and Report	140,200 (16,600)[1]	0	140,200 (82,720)[6]	30,340	30,340	170,540
J231R	Subtask 5.2 Site Development and Sludge Spreading	246,500 (61,100)[1]	0	246,500 (152,070)[6]	(30,000)[7] (15,000)[8]	(45,000)	201,500
J231S	Subtask 5.3 Sludge and Disposal Site Monitoring	219,000 (20,200)[1]	5,290[4]	224,290 (78,290)[6]	8,340 (45,900)[7] (30,000)[8]	(67,560)	156,730
	Task 6 - Miscellaneous Use Determination						
J231T	Subtask 6.1 Microbiological Study	89,800 (6,800)[1]	0	89,800 (25,020)[6]	(45,000)[7] (15,000)[8]	(60,000)	29,800
J231U	Subtask 6.2 Virus Studies	99,800 (6,800)[1]	58,850[4] 0	158,650 (21,190)[6]	(95,000)[7] (10,000)[8]	(105,000)	53,650

Table 2-2 Continued

Job Number (Subacc't)	Subtask Number and Title	12/10/76 Authorized Estimate	1/1/78 Authorized Scope Changes	1/1/78 Authorized Estimate	5/30/78 Proposed Revisions		5/30/78 Current Estimate
					Detail	Net	
	Task 7 - Environmental Impact Reports						
J232A	Subtask 7.1 Solid Storage Basins EIR	118,600	0	118,600 (76,940)[6]	105,000	105,000	223,600
J232B	Subtask 7.2 Dedicated Land Disposal EIR	109,600	0	109,600 (3,910)[6]	(105,000)[7]	(105,000)	4,600
	TOTAL	1,833,000 (411,000)[1]	93,410	1,926,410 (1,173,840)[6]	722,630 (323,400)[7] (70,000)[8] (6,620)[9]	322,610	2,249,020

[1] Monies spent prior to November 1, 1976
[2] Separate study costs, not included in SSMP budget
[3] Included in Subtask 1.1 costs
[4] Authorization executed May 23, 1977
[5] Letter of Authorization dated September 20, 1977
[6] Monies spent as of January 1, 1978
[7] Savings in 1978-79 budget costs
[8] Re-allocated unspent 1976-77 funds
[9] Unspent 1976-77 funds, re-allocated within same Task

Table 2-3. Project Cost and Profit Calculation
(dollars)

Item No.	Description	Estimated Cost	Profit on		Total Project Cost
			Labor and Other Direct Costs	Subcontractors	
1.	Total Estimated Cost and Profit for SSMP as of January 1, 1978				
	Amendment 10 - December 10, 1976	1,322,443.64	81,017.33	18,514.21	1,421,975.18
	Amendment 10A - May 23, 1977				
	Scope Change No. 1 (Ref. Subtask 5.3)	5,136.30	93.67	64.82	5,294.79
	Scope Change No. 2 (Ref. Subtask 3.1, 3.2)	3,850.00	269.50	---	4,119.50
	Scope Change No. 3 (Ref. Subtask 6.2)	57,466.75	624.40	757.28	58,848.43
	Cost Change No. 1 (Ref. Subtask 4.5)	2,312.74	---	---	2,312.74
	Total, Amendment 10 and 10A	1,391,209.43	82,004.90	19,336.31	1,492,550.64
2.	Letters of Authorization approved by District September 20, 1977				
	Scope Change No. 4 (Ref. Subtask 4.3)	12,994.62	1,024.00	---	14,018.62
	Scope Change No. 5 (Ref. Subtask 4.5)	8,517.28	297.72	---	8,815.00
	Total, Letters of Authorization	21,511.90	1,321.72	---	22,833.62
3.	Total Authorized as of January 1, 1978	1,412,721.33	83,326.62	19,336.31	1,515,384.26
4.	Program Revisions - Scope Reductions and Cost Reductions				
	Task 2 (SAC labor only)	(2,110.00)	(390.00)		(2,500.00)
	Task 5				
	Scope Reduction (Detail, see Table 2-4)	(73,819.00)	(2,081.00)	---	(75,900.00)
	Cost Reduction (Detail, see Table 2-5)	(45,000.00)	---	---	(45,000.00)
	Task 6				
	Scope Reduction (Detail, see Table 2-6)	(139,111.00)	(889.00)	---	(140,000.00)
	Cost Reduction (Detail, see Table 2-7)	(25,000.00)	---	---	(25,000.00)
	Total Program Revisions (Scope and Cost)	(285,040.00)	(3,360.00)	---	(288,400.00)
5.	Proposed Program Revisions - Scope Additions (Detail, see Sections 1 and 3)				
	Labor (Direct and Indirect) (Detail, see Table 2-9)	86,897.71	16,076.08	---	102,973.79
	Other Direct Costs				
	Equipment, Materials, and Supplies (Detail, see Table 2-10)	26,155.00	1,830.85	---	27,985.85
	Subcontractors (Detail, see Table 2-11)	475,365.61	---	4,689.09	480,054.70
	Total Program Revisions (Scope Additions)	588,418.32	17,906.93	4,689.09	611,014.34
6.	Total Estimated Revised Program Cost (Calculation: Item 1 plus Item 2 times Item 4 plus Item 5 equals Item 6)	1,716,099.65	97,873.55	24,025.40	1,837,998.60

Table 2-4. Task 5 - Scope Reductions

		Savings (dollars)				
			Sacramento Area Consultants			
Subtask	Description	Subcontracts	Labor[1]	Other Direct	Profit[2]	Total
5.2	1978 Transfer of Spreading Tractor to District cost	30,000				30,000
5.3	50% reduction in harvested sludge samples			1,500	100	1,600
	Transfer of 6 months of Morrison Creek monitoring to District cost		987	9,000	813	10,800
	Transfer of 1979 DLD site monitoring to District cost	17,396	1,067	13,869	1,168	33,500
Total		47,396	2,054	24,369	2,081	75,900

[1] Includes direct and indirect costs

[2] Includes profit on direct, indirect and other direct costs computed at (0.185 x labor) plus (0.07 x other direct costs).

Table 2-5. Task 5 - Cost Reductions

		Savings (dollars)			
			Sacramento Area Consultants		
Subtask	Description	Subcontracts	Labor	Other Direct	Total
5.3	Reduced rental price of 1977 spreading equipment	15,000			15,000
	Reduced number of surface runoff, soil solution, and soil samples required to monitor DLD due to low rainfall.				
	Reduced number of harvested sludge samples.				
	Reduced number of water samples required to monitor Morrison Creek due to low rainfall.	15,775		14,225	30,000
Total		30,775		14,225	45,000

Table 2-6. Task 6 - Scope Reductions

		Savings (dollars)				
			Sacramento Area Consultants			
Subtask	Description	Subcontracts	Labor[1]	Other Direct	Profit[2]	Total
6.1	Microbiological Study	42,632	1,998		370	45,000
6.2	Virus Study	91,673	2,808		519	95,000
Total		134,305	4,806		889	140,000

[1] Includes direct plus indirect costs

[2] Includes profit on direct, indirect and other direct costs computed at (0.185 x labor) plus (0.07 x other direct costs).

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Table 2-7. Task 6 - Cost Reductions

		Savings (dollars)			
			Sacramento Area Consultants		
Subtask	Description	Subcontracts	Labor	Other Direct	Total
6.1	Microbiological Study	11,011	3,989		15,000
6.2	Virus Study	8,904	1,096		10,000
Total		19,915	5,085		25,000

Table 2-8. Derivation of Values for Form 5700-41 (dollars)

No.[1]	Item Description	S.A.C. Labor		Other[8] Direct	Total
		Direct	Indirect		
2	Letters of Authorization[2]				
	Scope Change No. 4	416.16	578.46	12,000.00	12,994.62
	Scope Change No. 5	673.34	935.94	6,908.00	8,517.28
	Subtotal	1,089.50	1,514.40	18,908.00	21,511.90
4	Program Revisions-Scope and Cost Reductions				
	Task 2[3]	748.39	1,361.61	-0-	2,110.00
	Task 5[4]	763.57	1,290.43	116,765.00	118,819.00
	Task 6[5]	3,676.95	6,214.05	154,220.00	164,111.00
	Subtotal	5,188.91	8,866.09	270,985.00	285,040.00
5	Proposed Program Revisions	32,303.98[6]	54,593.73[6]	501,520.61[7]	588,418.32
	TOTAL[10]	28,204.57	47,242.04	249,443.61	324,890.22[9]

[1] Corresponds to Item numbers on Table 2-3.

[2] Values from Form 5700 submitted with original proposals.

[3] Values derived from Table 2-3

[4] Values derived from Tables 2-4 and 2-5.

[5] Values derived from Tables 2-6 and 2-7.

[6] Values from Table 2-9.

[7] Value from sum of Table 2-10 and 2-11.

[8] Includes subcontractor costs.

[9] Value differs from total Net Revision on Tables 2-1 and 2-2 because it includes scope changes 4 and 5 and does not include profit.

[10] Total equals Item 2 plus 5 minus 4.

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS
(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE Sacramento Regional County Sanitation District	2. GRANT NUMBER C-06-0938-010
3. NAME OF CONTRACTOR OR SUBCONTRACTOR Sacramento Area Consultants	4. DATE OF PROPOSAL May 30, 1978
5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)* 723 S Street Sacramento, California 95814	6. TYPE OF SERVICE TO BE FURNISHED Engineering services for the Sewage Sludge Management Program

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
See Table 2-8		$	$	
DIRECT LABOR TOTAL:				$ 28,204.57
8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	
See Table 2-8		$	$	
INDIRECT COSTS TOTAL:				$ 47,242.04
9. OTHER DIRECT COSTS See Table 2-8				
a. TRAVEL			ESTIMATED COST	
(1) TRANSPORTATION			$	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$	
b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	
		$	$	
EQUIPMENT SUBTOTAL:				
c. SUBCONTRACTS			ESTIMATED COST	
			$	
SUBCONTRACTS SUBTOTAL:			$	
d. OTHER *(Specify categories)*			ESTIMATED COST	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 249,443.61
10. TOTAL ESTIMATED COST				$ 324,890.22
11. PROFIT				$ 20,557.74
12. TOTAL PRICE				$ 345,477.96

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES (*Indicate basis for price comparison*)	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☒ YES ☐ NO *(If "Yes" give name address and telephone number of reviewing office)*

Environmental Protection Agency
Sacramento Audit Office
Old Post Office Building
Sacramento, California 95814

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41 CFR 1-15.4

14c.

This proposal is submitted for use in connection with and in response to *(1)* SRCSD acceptance of 2/9/78 Recommended Program Revisions. This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* May 30, 1978 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) May 30, 1978
DATE OF EXECUTION

SIGNATURE OF PROPOSER

General Manager
Sacramento Area Consultants
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

14

Table 2-9. Direct Labor Summary* (1978)

Grade	Adjusted Rate ($)	Hours	Cost ($)
10	19.483	215	$ 4,188.85
12	15.880	36	571.68
13	14.413	78	1,124.21
15	11.343	159	1,803.54
16	9.920	1871	18,560.32
17	8.362	50	418.10
34	7.118	156	1,110.41
35	5.916	228	1,348.85
36	4.893	36	176.15
64	7.118	15	106.77
65	5.916	462	2,733.19
66	4.893	20	97.86
67	4.003	16	64.05
TOTAL DIRECT COST			$32,303.98
INDIRECT COST (1.69)x(32,303.98)			$54,593.73
TOTAL DIRECT AND INDIRECT COSTS			$86,897.71

*Project manhours by Subtask and grade are presented in Tables 2-9.1 through 2.9-10.

Profit on direct plus indirect costs equals: (0.185) times ($86,897.71) equals $16,076.08.

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Table 2-10. Equipment, Material, and Supplies

Subtask	Item	Cost
3.3	Laboratory Analysis	
	Raw sludge: cadmium and chromium	$ 350.00
	Influent/effluent: lead and nickel	1,820.00
	Printing, expendable supplies	1,500.00
	Subtotal, Subtask 3.3	$ 3,670.00
4.1	Pilot 3hp SSB Aerator Modification	
	Rotor modifications	922.20
	Mounting cable	720.80
	Cable pullers	[illegible]8.38
	Repair cracked pontoon, modify motor mount, set up and install in SSB	664.71
	Cable harness	150.00
	Estimated costs for maintenance	743.91
	Laboratory	
	SSB surface layer	1,080.00
	SSB solids	2,400.00
	Mixer study	50.00
	Travel and reproduction	260.00
	Subtotal, Subtask 4.1	$ 7,440.00
4.3	Laboratory, SSB groundwater wells	
	Mineral and nitrogen	$ 2,900.00
	Complete analysis	290.00
	Printing, expendable supplies	1,500.00
	Subtotal, Subtask 4.3	$ 5,320.00
4.6.1	Reproduction, communications, supplies	$ 1,500.00
	Aerial photography	2,500.00
	Travel	125.00
	Subtotal, Subtask 4.6.1	$ 4,125.00

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Table 2-10 Continued

Subtask	Item	Cost
4.8	Report printing	$ 1,500.00
	Travel	190.00
	Toll calls	120.00
	Expendable supplies	240.00
	Subtotal, Subtask 4.8	$ 2,050.00
5.1	Printing, expendable supplies	$ 1,550.00
	Travel	300.00
	Subtotal, Subtask 5.1	$ 1,850.00
5.3	Laboratory, DLD soil samples	$ 1,200.00
	Reproduction, expendable supplies	500.00
	Subtotal, Subtask 5.3	$ 1,700.00
	TOTAL EQUIPMENT, MATERIAL, SUPPLIES	$26,155.00

Profit on other direct costs equals:
(0.07) times ($26,155.00) equals $1,830.85.

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Table 2-11. Summary of Subcontracts

Subtask	Item	Cost
4.1	Field personnel (Diurnal Study)	$ 150.00
4.3	Baier Agronomy Inc. and R. Burau, Associate Professor, UC-Davis	$ 5,000.00
	Lowry and Associates	$ 2,000.00
4.6	Eutek Inc.	$431,883.94
4.6.1	Eutek Inc.	$ 32,831.67
	Lowry and Associates	$ 1,500.00
5.3	Baier Agronomy Inc.	$ 2,000.00
	TOTAL COST OF SUBCONTRACTORS	$475,365.61

Table 2-9.1

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SUMMARY OF HOURS -- SSMP

RECOMMENDED PROGRAM REVISIONS

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Subtask 3.3	24						259							35				120			
Subtask 4.1	15						216							8				24			
Subtask 4.3	8						41							45				45			
Subtask 4.6	28						150							40				40			
Subtask 4.6.1	50		14	40		150	70	50					70	20				70			
Subtask 4.8	32						400							40				72			
Subtask 5.1	50		22	38		9	560						86		36		15	53	20	16	
Subtask 5.3	8						80							40				38			
Subtask 1.2							95														
TOTALS	215		36	78		159	1871	50					156	228	36		15	462	20	16	

Table 2-9.2

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 1.2 -- SSMP

MANAGEMENT

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Contract Revision							95														
TOTALS							95														

Table 2-9.3

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 3.3 -- SSMP

SOURCE SURVEY, PHASE II --
PREPARATION OF PROGRESS REPORT

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Sample retrieval							19														
Management, Coordination and Report Preparation	24						240							35				120			
TOTALS	24						259							35				120			

Table 2-9.4

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 4.1 -- SSMP
SOLIDS STORAGE BASIN OPERATION AND
PERFORMANCE EVALUATION PROGRAM

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Auarterly sampling of Quarterly Sampling of SSB Solids							24														
SSB Mixer Study:																					
1. Project Supervision	11																				
2. Project manager							151														
3. Report Preparation	4						41							8				24			
TOTALS	15						216							8				24			

Table 2-9.5

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK SUBTASK 4.3 -- SSMP

SSB STUDIES, SSB GROUNDWATER MONITORING
AND SITE ENGINEERING

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Finalize SSB Bottom Permeability Report	8						41							45				46			
TOTAL	8						41							45				46			

Table 2-9.6

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 4.6 -- SSMP

DEVELOPMENT OF ODOR CRITERIA FOR LARGE EMISSION AREAS

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Field Supervision and Review of Water Quality Data	4						134							40				40			
Review of Interim Report on Odor Occurrence Risk	8																				
Review of Final Report on Odor Occurrence Risk	16						16														
TOTALS	28						150							40				40			

Table 2-9.7

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 4.6.1 -- SSMP
DESIGN AND CONSTRUCTION OF INDUCED VERTICAL MIXING SYSTEM

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Task 1 - Project Management	20																				
Task 2 - Development of Design Criteria (Subcontractor)																					
Task 3 - Design																					
Task 3A	10		7	15		80	20	40					70	20				10			
Task 3B	10		7	15		40	10	10										30			
Task 3C	4			10		30												30			
Task 4 - Services During Construction	6						40														
TOTALS	50		14	40		150	70	50					70	20				70			

Table 2-9.8

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 4.8 -- SSMP
SOLIDS STORAGE BASIN STUDY --
MANAGEMENT, DATA REDUCTION AND
REPORT PREPARATION

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Management of SSB Program	8						280											24			
Finalizing SSB Studies Report	24						120							40				48			
TOTALS	32						400							40				72			

Table 2-9.9

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 5.1 -- SSMP
DEDICATED LAND DISPOSAL STUDY
MANAGEMENT AND REPORT

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Project Management	16																				
Prepare Specs. for Sludge Disposal and Tillage Equipment	16		8	12		9	180						43		16		7	21	10	8	
Prepare Plans and Specs. for Sludge Delivery System	14		14	22			240						43		20		8	24	10	8	
Management of Bidding and Construction	4			4			140											8			
TOTALS	50		22	38		9	560						86		36		15	53	20	16	

Table 2-9.10

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM
SEWAGE SLUDGE MANAGEMENT PROGRAM (J231)

TASK Subtask 5.3 -- SSMP

Dedicated Land Disposal Study --
SLUDGE AND DISPOSAL SITE MONITORING

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Development of Long-term DLD Monitoring Program	8						80							40				38			
TOTALS	8						80							40				38			

SECTION 3

SEWAGE SLUDGE MANAGEMENT PROGRAM

SUMMARY OF DISTRICT COSTS IN SUPPORT OF SSMP REVISIONS

Table 3-1. Summary of District Costs in Support of SSMP Revisions

Budget Fiscal Year	Description	Cost
1977-78	Monitoring for Phase II Source Survey - sampling and analysis (reference SSMP Subtask 3.3)	$ 15,000
1978-79	Six-month SSB surface layer and solids monitoring - sampling and analysis (reference SSMP Subtask 4.1)	5,000
1978-79	Six-month SSB groundwater monitoring - sampling and analysis (reference SSMP Subtask 4.3)	4,000
1978-79	Construct intermediate levee in earthen basin of ESB (reference SSMP Subtask 4.6.1)	8,000
1978-79	ESB filling and drawing by Central Treatment Plant staff (240 manhours @ $35/hr. Diesel fuel, $1,000) (reference SSMP Subtask 4.6.1)	10,000
1978-79	Wind machine rental - 4 machines for 21 weeks (reference SSMP Subtask 4.6.1)	45,000
1977-78	SSB Barriers - Contract No. 1180. 6,500 lineal feet of 12-foot high wall (reference SSMP Subtask 4.6.1)	365,000
1977-78	Purchase of three direct reading olfactometers (reference SSMP Subtask 4.6.1)	19,300
1978-79	Construction inspection, SSB Barrier - Contract No. 1180 (reference SSMP Subtask 4.6.1)	36,500
1977-78	Construction inspection, Sludge Delivery System - Contract No. 1170 (reference SSMP Subtask 5.2)	5,400

Table 3-1 Continued

Budget Fiscal Year	Description	Cost
1977-78	Purchase of Portable Dredge (reference SSMP Subtask 5.2)	$120,020
1977-78	Purchase of Subsurface Injection Equipment (reference SSMP Subtask 5.2)	95,920
1977-78	Purchase of Booster Pump Assembly (reference SSMP Subtask 5.2)	20,183
1977-78	Sludge Delivery System - Contract No. 1170 (reference SSMP Subtask 5.2)	53,892
1977-78	Lease of DLD covering tractor and tillage tools - 5 months (reference SSMP Subtasks 5.1 and 5.2)	22,500
1978-79	Six months of Morrison Creek water monitoring - sampling and analysis (reference SSMP Subtask 5.3)	10,800
1978-79	1979 DLD site monitoring program (reference SSMP Subtask 5.3)	33,500
	TOTAL DISTRICT COSTS	$870,015

SEWAGE SLUDGE MANAGEMENT PROGRAM

REVISIONS TO MAY 30, 1978
RECOMMENDED PROGRAM REVISIONS

June 19, 1978

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

June 19, 1978

Mr. Norm Bessette
Sacramento Regional County
Sanitation District
827 Seventh Street, Room 304
Sacramento, California 95814

J231B

SEWAGE SLUDGE MANAGEMENT PROGRAM
REVISIONS TO MAY 30, 1978 RECOMMENDED PROGRAM REVISIONS

This letter documents the revisions to the May 30, 1978 Recommended Program Revisions, as requested by the District.

Enclosed is the revised Form 5700-41 (Attachment 1) prepared in accordance with your recommendations. This supersedes the Form 5700-41 and Table 2-8 included in the May 30 document. The principal difference in the revised Form 5700-41 is the addition of the cost reductions to the Total Estimated Cost and the computation of subcontractor profit based on the revised Total Estimated Cost. In addition, the costs on the revised Form 5700-41 are broken down into three categories: (1) Letters of Authorization (Scope Changes 4 and 5), (2) Proposed Program Revisions, and (3) Scope Reductions due to Revised Program.

Adjustments in the profit claimed in the Letters of Authorization and the Scope Reductions were also made. The amounts of these adjustments are included in the Revised Table 2-3 (Attachment 2). Revised Table 2-3 also shows the revised total project cost, exclusive of the $411,000 spent under the interim authorization, J222A.

Attachment 3 supersedes the "Project Cost and Profit Calculation" section on page 2-1 of the subject document.

As a result of the changes described above, the costs presented in Tables 2-1 and Table 2-2 are slightly in error due to the revised profit calculation; the total amount of this difference is $437.56.

We are prepared to answer any questions you may have on this revision.

SACRAMENTO AREA CONSULTANTS

Allen K. Wolfenden

Allen K. Wolfenden
Project Engineer

AKW:dlb
Attachments
cc: W. Anderson, L. Hoag, W. Uhte

ATTACHMENT 1

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I-GENERAL

1. GRANTEE Sacramento Regional County Sanitation District	2. GRANT NUMBER C-06-0938-010
3. NAME OF CONTRACTOR OR SUBCONTRACTOR Sacramento Area Consultants	4. DATE OF PROPOSAL June 19, 1978
5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)* 723 S Street Sacramento, California 95814	6. TYPE OF SERVICE TO BE FURNISHED Engineering services for the Sewage Sludge Management Program

PART II-COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTIMATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Letters of Authorization (Scope Changes 4, 5)		$	$ 1,089.50	
Proposed Program Revisions			32,303.98	
Less: Scope Reductions due to Revised Program			(3,334.57)	
DIRECT LABOR TOTAL:				$ 30,058.91
8. INDIRECT COSTS *(Specify indirect cost pools)*	RATE	× BASE =	ESTIMATED COST	
Letters of Authorization (Scope Changes 4, 5)		$	$ 1,514.40	
Proposed Program Revisions			54,593.73	
Less: Scope Reductions due to Revised Program			(5,635.43)	
INDIRECT COSTS TOTAL:				$ 50,472.70
9. OTHER DIRECT COSTS				
a. TRAVEL			ESTIMATED COST	
(1) TRANSPORTATION			$	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$	
b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	QTY	COST	ESTIMATED COST	
Letters of Authorization (Scope Change 4, 5)		$	$ 6,335.00	
Proposed Program Revisions			26,155.00	
Less: Scope Reductions to to Revised Program			(24,369.00)	
EQUIPMENT SUBTOTAL:			8,121.00	
c. SUBCONTRACTS			ESTIMATED COST	
Letters of Authorization (Scope Changes 4, 5)			$ 12,573.00	
Proposed Program Revisions			475,365.61	
Less: Scope Reductions due to Revised Program			(181,701.00)	
SUBCONTRACTS SUBTOTAL:			$ 306,237.61	
d. OTHER *(Specify categories)*			ESTIMATED COST	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 314,358.61
10. TOTAL ESTIMATED COST				$ 394,890.22
11. PROFIT				$ 20,995.30
12. TOTAL PRICE				$ 415,886.52

EPA Form 5700-41 (2-76)

PAGE 1 OF 5

5

Form Approved
OMB No. 158-R0144

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES *(Indicate basis for price comparison)*	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☒ YES ☐ NO *(If "Yes" give name address and telephone number of reviewing office)*

Environmental Protection Agency
Sacramento Audit Office
Old Post Office Building
Sacramento, California 95814

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41 CFR 1-15.4

14c.

This proposal is submitted for use in connection with and in response to *(1)* SRCSD acceptance of 2/9/78 Recommended Program Revisions. This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* June 19, 1978 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) June 19, 1978
DATE OF EXECUTION

Lyle Hoag
SIGNATURE OF PROPOSER

General Manager
Sacramento Area Consultants
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

Table 2-3. Project Cost and Profit Calculation
(dollars)

Item No.	Description	Estimated Cost	Profit on Labor and Other Direct Costs	Profit on Subcontractors	Total Project Cost
1.	Total Estimated Cost and Profit for SSMP as of January 1, 1978				
	Amendment 10 - December 10, 1976	1,322,443.64	81,017.33	18,514.21	1,421,975.18
	Amendment 10A - May 23, 1977				
	Scope Change No. 1 (Ref. Subtask 5.3)	5,136.30	93.67	64.82	5,294.79
	Scope Change No. 2 (Ref. Subtask 3.1, 3.2)	3,850.00	269.50	---	4,119.50
	Scope Change No. 3 (Ref. Subtask 6.2)	57,466.75	624.40	757.28	58,848.43
	Cost Change No. 1 (Ref. Subtask 4.5)	2,312.74	---	---	2,312.74
	Total, Amendment 10 and 10A	1,391,209.43	82,004.90	19,336.31	1,492,550.64
2.	Letters of Authorization approved by District September 20, 1977				
	Scope Change No. 4 (Ref. Subtask 4.3)	12,994.62	604.00	---	13,598.62
	Scope Change No. 5 (Ref. Subtask 4.5)	8,517.28	321.17	---	8,838.45
	Total, Letters of Authorization	21,511.90	925.17	---	22,437.07
3.	Total Authorized as of January 1, 1978	1,412,721.33	82,930.07	19,336.31	1,514,987.71
4.	Program Revisions - Scope Reductions and Cost Reductions				
	Task 2 (SAC labor only)	(2,110.00)	---	---	(2,500.00)
	Task 5				
	Scope Reduction (Detail, see Table 2-4)	(73,819.00)	---	---	(75,900.00)
	Cost Reduction (Detail, see Table 2-5)	(45,000.00)	---	---	(45,000.00)
	Task 6				
	Scope Reduction (Detail, see Table 2-6)	(139,111.00)	---	---	(140,000.00)
	Cost Reduction (Detail, see Table 2-7)	(25,000.00)	---	---	(25,000.00)
	Total Program Revisions (Scope and Cost)	(285,040.00)	(3,365.29)	---	(288,405.29)
5.	Proposed Program Revisions - Scope Additions (Detail, see Sections 1 and 3)				
	Labor (Direct and Indirect) (Detail, see Table 2-9)	86,897.71	16,076.08	---	102,973.79
	Other Direct Costs				
	Equipment, Materials, and Supplies (Detail, see Table 2-10)	26,155.00	1,030.85	---	27,985.85
	Subcontractors (Detail, see Table 2-11)	475,365.61	---	5,528.48	480,894.09
	Total Program Revisions (Scope Additions)	588,418.32	17,906.93	5,428.48	611,853.73
6.	Total Estimated Revised Program Cost (Calculation: Item 1 plus Item 2 minus Item 4 plus Item 5 equals Item 6)	1,716,099.65	97,471.71	24,864.79	1,838,436.15

Project Cost and Profit Calculation

Attached EPA Form 5700-41 depicts cost and profit calculations which result from program changes beyond the last amendment dated May 23, 1977. Scope changes 4 and 5 (previously authorized) incurred a total of $1,089.50 Direct Labor and $1,514.40 Indirect Labor plus $6,335 Other Direct and $12,573 of subcontractor costs.

The proposed scope revisions result in an additional $32,303.98 of Direct Labor and $54,593.73 Indirect Labor (see Table 2-9) plus $26,155 Other Direct Costs (Table 2-10) and $475,365.61 of additional subcontractor costs (Table 2-11).

This 5700-41 also adjusts for scope reductions of items previously approved. Scope reductions account for a total of $8,970 of Direct and Indirect costs. This is derived from $2,110 of Direct and Indirect scope reductions savings from Task 2, $2,054 scope reductions from Task 5 (Table 2-4), and $4,806 scope reductions from Task 6 (Table 2-6). Scope reductions of $24,369 for ODC (Table 2-4) and $181,701 (Tables 2-4 and 2-6) for subcontractor costs were also incurred.

Cost reductions of $70,000 (Tables 2-5 and 2-7) were also incurred and are not reflected on the 5700-41. An adjustment to the limiting amount will be made to account for this cost reduction.

SEWAGE SLUDGE MANAGEMENT PROGRAM

PROPOSED SCOPE CHANGES

November 6, 1978

Prepared by:

Lyle Hoag
Warren Uhte
Allen Wolfenden
Perry Schafer
Geoffrey Marmas
Merle Hunter

Sacramento Area Consultants
Sacramento, California

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

November 6, 1978

Mr. William N. Anderson
Sacramento Regional Wastewater
Management Program
9660A Ecology Lane
Sacramento, California 95827

J231B

SEWAGE SLUDGE MANAGEMENT PROGRAM
PROPOSED SCOPE CHANGES

This proposal documents proposed scope changes to four subtasks and the addition of one subtask to the Sewage Sludge Management Program (SSMP). It is proposed that SSMP site planning, topographic mapping, and Solid Storage Basis (SSB) site soil investigations be added as a new task (Task 8); a feasibility study of surface sludge spreading systems be added to existing Subtask 5.1; additional Dedicated Land Disposal (DLD) site soils monitoring be added to existing Subtask 5.3 and additional work for SSMP EIR scope changes to be added to existing Task 7. In the following sections, work plans and associated costs are presented for each of the proposed changes.

Sacramento Area Consultants has begun work on all of these proposed changes except Subtask 5.1 additions per the District's September 12, 1978 letter authorization, to a budget limit of $45,000. It is estimated that the $45,000 budget will be expended by November 15, 1978. The prompt processing of this scope change is requested so that the schedule, attached to the District's August 28, 1978 letter to the State Water Resources Control Board, can be maintained. This letter and Attachments 1, 2, and 3 present detailed descriptions for the proposed work. Attachment 4 contains detailed cost estimates, man-hour projections, and the EPA Forms 5700-41.

Task 8 - Advanced Site Planning

Additional SSMP site planning and investigations are required prior to design of the SSBs. This work includes necessary topographic mapping and geotechnical investigations and conceptual planning and layout of the facilities. This involves evaluation of alternative locations and system operation of the SSBs, DLD, and sanitary landfill sites, and soils investigations for SSB and flood control levee sites.

The SSB layout, as included in the 1975 Regional Plant design, must be modified for several reasons. First, during the preparation of the SSMP Draft EIR, a significant archaeological site was discovered at the proposed location of two of the westerly SSBs. Therefore, the layout of the originally designed SSBs is no longer acceptable. Second, the original basin design was completed based on the assumption that SSB sludge would be reused on agricultural lands remote from the Regional Plant site. The present recommended plan calls for SSB sludge to be disposed of locally at on-site DLD areas. A relationship exists between sludge distribution costs and the distance between SSBs and DLD sites. Third, results of recent odor studies indicate that the location of the basins in relation to the prevailing winds, other SSBs, and the proximity to the plant boundary may influence downwind odors. The original layout was made with minimum consideration of these factors. Fourth, the development of barriers and wind machines as mitigating measures for unfavorable meteorological conditions has made the original 1975 design obsolete and costly. The irregular orientation of SSBs with the resultant extra area between basins and the pattern of three instead of four basins would be inefficient to the application of these mitigation measures. Fifth, the need for more flexibility in digested sludge supply piping to accommodate feeding SSBs during limited hours has made the originally designed twin supply system obsolete. The originally designed supernatant supplement system has also been found to be unnecessary. Therefore, it is logical that this system should be incorporated into a new digested sludge supply system designed to provide the flexibility of feeding three SSBs instead of two simultaneously with flows up to 1,000 gpm.

The original SSB layout, therefore, must be modified to take advantage not only of being able to locate the basins away from the archaeological site and in closer proximity to the DLD sites, but also to assure that SSB and DLD layout and locations are evaluated in relation to potential downwind odor impacts and the various configurations of digested sludge, SSB supply piping, and harvested sludge and DLD supply piping.

Subtask 8.1 - Site Planning and Geotechnical Investigations. The impacts of the alternative SSB and DLD sites will be evaluated. These evaluations will consider earthwork, piping, electrical, odor control, construction, operation, maintenance, and redesign costs. A supernatant control system will be developed. This evaluation will also include ash conveyance and covering systems.

Geotechnical investigation for SSB and levee construction must begin by October 1978 so that the report will be available for final design work in December 1978 and May 1979. Soils investigations will include evaluation of soils for suitability as levee embankment material and as a base for levee construction. Lowry and Associates' proposal for the conduct of their work is presented in Attachment 2.

The recommended site plan will be presented in a report to the District. The report will include a cost-effective analysis of each alternative plan. The cost for the work in this subtask is estimated to be $58,930. Attachment 1 presents a detailed outline of the work to be completed.

Subtask 8.2 - Topographic Mapping. Additional topographic mapping is required for the area proposed for SSBs and DLD. Costs outlined here will cover all photogrammetry and mapping required to prepare a 200-scale topographic map. Site mapping should proceed immediately so that topographic maps will be available for site planning and earthwork estimation for cost analysis. The work will provide complete topographic mapping of the area south of the existing SSBs and the area extending up to 2,500 feet south of Sims Road. Costs incurred under J366A and J365A for topographic mapping of this area have been included under this subtask. The total estimated costs for topographic mapping of the SSB and DLD sites are $24,620.

Subtask 5.1 Additions - Feasibility Study of Surface Sludge Spreading Systems. Surface spreading of sludge, followed by tilling, has been conducted on a trial basis from the middle of September to date. The results are encouraging. Approximately 0.1-foot of sludge is applied with each pass and then disked in within the day. The operation results in excellent mixing of the sludge and soil. The appearance of the soil after tillage is that of moist earth with slight traces of exposed sludge. Exposure of the moist surface to the atmosphere promotes more rapid drying which could permit high application rates or maintain a dryer soil sludge mix so as to minimize the chances for odors.

Surface spreading of sludge with an overhead distribution system would have the advantage of substantially less labor required per gallon of sludge spread. A DLD system utilizing an overhead distributor system would probably have a fixed distribution system for each field which would be supplied by a Mudcat and booster pump operating in a nearby SSB. This type of system would not require the close coordination between the Mudcat booster pump and the field operation that is required by the present subsurface injection system. Elimination of the 660-foot long, 4½-inch diameter injector feed hose would be a substantial cost savings due to its unsatisfactory wear characteristics. The high pressures required to maintain satisfactory flow rates would probably still be required to assure satisfactory operation of the fixed distributors. With two Mudcats and boosters pumping 1,400 gpm for six hours, only one tillage tractor would be required to disk in one day's sludge production as opposed to three subsurface injectors.

A potential problem in utilizing a center-pivot fixed distribution system is creation of aerosols from spraying sludge through nozzles. An alternative which might be satisfactory would spread sludge in a pattern similar to that used in a trickling filter distributor. Experience in spreading sludge with the subsurface injector and through gated irrigation pipe has shown that orifice size and configuration must be carefully designed to assure reliable nonclog operation.

It is proposed that a pilot study be conducted during the winter of 1978-79 to evaluate different orifice sizes and configurations that will provide nonclog and uniform sludge spreading at flow rates and boom travel rates compatible with existing overhead distribution systems.

Parallel to this pilot study will be the evaluation of existing center-pivot and lateral-move irrigation systems for adaptability to sludge-spreading orifices.

The following task outline presents the major elements of the proposed study.

- Acceptability of surface spreading to regulatory agencies.
    1. Aerosols
    2. Odors
- Evaluation of adaptability of water spreading systems to sludge spreading.
    1. Center-pivot system
    2. Lateral-move system
    3. Portable lateral-move system
    4. Portable center-pivot system
- System sizing of uniform sludge distribution
    1. Pilot test of various orifice sizes and distribution heads
    2. Optimization of boom travel speed to flow and spreading rate
- Alternative DLD configuration for surface spreading systems
- Recommended surface spreading system
    1. Cost Estimate
    2. Acceptability to regulatory agencies
    3. Environmental acceptability

It is estimated that this study will cost $29,140. This study will be completed prior to design of the DLD system. At that time, a decision will be made to incorporate the subsurface injector or a surface spreading system into the DLD layout.

Subtask 5.3 - Additional DLD Soils Monitoring. Analytical results from soil samples collected after the winter of 1977-78 indicated that nitrates and chlorides had leached below the deepest soil sample collection depth (42 inches) at two sites within the DLD. To document the severity of this leaching and to provide background data for the other soil sample sites, it was recommended that the scope be expanded and that all 12 sites be analyzed for the major cations and anions. Soil samples will be extracted from each site to the depth of the hardpan. A supplemental report will be prepared to present results of these analyses. Attachment 3 presents Baier Agronomy's proposal for this work. The estimated cost is $17,210.

Subtask 7.1 SSMP EIR. Several elements of the EIR have been expanded due to the need for additional information for decision making. These elements include the following additional scope changes:

- The evaluation of dewatered sludge cake disposal was greatly expanded in scope due to potential SSB odor problems. In late 1977, an analysis by Eutek, Inc., showed significantly higher odor risk with the SSBs than previously identified. This resulted in more detailed examination of the alternatives to the SSBs, i.e., mechanical dewatering and disposal. With District concurrence, two surveys were conducted of other locations in the United States where dewatered sludge disposal is being practiced on a large scale. Total price for this work is about $4,210.

- The District requested that Regional Plant buffer land needs, related to solids disposal, be evaluated for the EIR. This was undertaken in response to odor and aesthetic concerns of the SSB-DLD project. This analysis was budgeted at approximately $2,500.

- The analysis of alternative solids disposal systems was expanded in the spring of 1978 to include more detailed engineering and cost estimates than previously planned for the EIR. The scope (from the December 1976 SSMP revisions which added Task 7) included only a simple update of capital and O&M costs from previous SAC reports. However, in the spring of 1978, the District requested, through its review of preliminary material, detail such that new preliminary engineering and costing work had to be conducted. This work required about six man-weeks of effort at a price of about $12,100.

- An updated solids projection analysis will be completed for the Final SSMP EIR. This is needed because recent information indicates that seasonal BOD loads are higher than were anticipated when the Regional Plant design was completed. Several additional years of BOD and suspended solids loading information are now available for use in revising Regional Plant sludge production projections. These revised projections will require 2½ man-weeks at a cost of $4,400.

The total price for SSMP EIR scope changes is estimated to be $23,210.

Summary

The total estimated price for additional work under the SSMP is as follows:

Subtask	Description	Amount
8.1	Advanced Site Planning	$58,930
8.2	Topographic Mapping	24,620
5.1	Feasibility Study of Surface Sludge Spreading Systems	29,140
5.3	Additional DLD Soils Monitoring	17,210
7.1	SSMP EIR	23,210
	Total Price	$153,110

Attachment 4 presents detailed cost estimates, man-hour projections, and EPA Forms 5700-41 for the proposed scope changes.

We are prepared to answer any questions or supply any additional cost data that are required to process this proposal.

SACRAMENTO AREA CONSULTANTS

Lyle N. Hoag
General Manager

Attachments
LNH:PLS:mjn

cc: M. Hunter
G. Marmas
P. Schafer
W. Uhte
A. Wolfenden

ATTACHMENT 1

Sewage Sludge Management Program
Subtask J231K - Site Planning and Soils Investigation

I. Introduction including summary of previously developed design criteria.

II. SSB-DLD System

  A. Development of alternative SSB-DLD site plans. Selection of viable alternatives on basis of operation and maintenance, environmental, compatibility, and cost considerations.

  B. Evaluation of Alternative SSB-DLD Site Plans

    1. Relative capital costs

      a. Earthwork
      b. Piping and pumping system
      c. Electrical system
      d. Odor control system
      e. Supernatant control system
      f. DLD runoff storage and treatment

    2. Operation and maintenance considerations

      a. Relative costs
      b. SSB loading
      c. SSB harvesting
      d. Supernatant control
      e. Odor control
      f. Maintenance problems

    3. Environmental factors

      a. Odor risk
      b. Visual impacts
      c. Surface water quality protection
      d. Ground water quality protection

    4. Compatibility and flexibility

      a. Surface spreading options
      b. Future expansion

III. Ash, Grit, Scum and Screenings Disposal Systems

  A. Selection of alternative systems.

B. Evaluation of Alternative Systems

1. Relative capital costs

a. Materials conveyance systems
b. Interim storage
c. Covering systems

2. Operation and maintenance considerations

a. Periods of operation
b. Operation during incinerator outage

3. Environmental factors

a. Odor risk
b. Visual impact
c. Surface and groundwater quality protection

4. Compatibility and flexibility

a. Site compatibility with SSB's, DLD and levee
b. Future expansion

IV. Flood Control Systems

A. Alternative Flood Control Levee Alignments

B. Evaluation of Alternative Alignments

1. Relative capital costs

a. Earthwork and slope protection
b. Uncontaminated runoff pumping station

2. Operation and considerations

3. Environmental factors

a. Visual impacts
b. Archaeological site
c. Borrow pit

4. Compatibility with future requirements.

V. Selection and Description of Recommmended SSMP Site Development Plan

A. SSB-DLD Site Plan

  - B. Ash, Grit, Scum, and Screening Disposal Plan
  - C. Flood Control Levee System

VI. Soils Investigation by Lowry and Associates

  - A. Alternative SSB sites
  - B. Flood control levee alignment

1978 Supplemental Soil Sampling and Analysis Program Costs

Sample Collection: 504 samples		
2 men, 7 days @ $13.07/hr.	$1463.84	
1 man, 7 days @ $38.38/hr.	2149.28	
Mileage, @ 25¢/mi.	259.00	
Total Collection Cost		$3872.12
Sample Preparation		
Drying, 1 man, 2 days @ $18.36/hr.	293.76	
Grinding, 1 man, 3 days @ $18.36/hr.	440.64	
Saturation extracts, 1 man, 8 days @ $18.36/hr.	1175.04	
Mileage, @ 25¢/mi.	259.00	
Total Preparation Cost		$2168.44
Laboratory Analysis		
1 man, 20 days @ $18.36/hr.	2937.60	
1 man, 10 days @ $13.07/hr.	1045.60	
1 man, 5 days @ $38.38/hr.	1535.20	
Mileage, @ 25¢/mi.	647.50	
Equipment rental	337.76	
Laboratory supplies & repairs	400.00	
Total Laboratory Analysis Cost		$6903.66
Supplemental Report Preparation		
10 days @ $38.38/hr.	3070.40	
5 days @ $13.07	522.80	
Total Report Cost		$3593.20
Total Supplemental Soil Sampling and Analysis Cost		$16537.42

ATTACHMENT 2

LOWRY & ASSOCIATES
[illegible]

October 5, 1978

Sacramento Area Consultants
Attention: Allen Wolfenden
723 S Street
Sacramento, CA 95814

PROPOSED SOLID STORAGE BASINS
AND PERIMETER EMBANKMENT
Dedicated Land Disposal Site
Sacramento Regional Wastewater Treatment Plant
Sacramento, California

As discussed with you, we are submitting this proposal for the performance of geotechnical studies for the subject construction. We have considered the drawing that you have supplied, and have located previously completed LOWRY & associates borings on that drawing. We also have reviewed work performed by Reinard W. Brandley for the construction of the existing solid storage basins.

Our proposed scope of work is divided into two segments: the solid storage basins, and the DLD site perimeter embankment. Separate reports would be issued for each of the studies.

Solid Storage Basins

The proposed solid storage basins have not been specifically sited but will be located within the DLD site. It will be necessary to provide boring coverage for the entire DLD area. Our proposed scope of work would include the drilling of approximately 22 borings to an average depth of 25 feet below existing ground surface. These borings would be located between borings drilled in conjunction with previous LOWRY & associates studies, and would result in an average boring-to-boring spacing of approximately 800 feet for the study area. The borings would extend previous exploration of the DLD to include the addition southerly of the line defined by Simms Road.

Relatively undisturbed soil samples would be obtained from the borings and selected samples would be subjected to laboratory testing to define their engineering properties, principally permeability. Tests also would be performed upon recompacted bulk samples recovered from selected areas to assess embankment stability and seepage characteristics. This information also would be useful for determination of subgrade permeabilities of backfilled borrow source areas.

P.O. BOX 13340 • SACRAMENTO, CALIFORNIA 95813 • AREA 916 929-9012

Following completion of field work, compilation of data and engineering analysis, a formal report would be prepared, containing a boring location plan (including the locations of borings drilled for previous studies), boring logs, and laboratory test results, as well as conclusions and recommendations regarding site preparation, including suggested earthwork specifications, and embankment design and potential settlement.

DLD Site Perimeter Embankment

It is understood that this construction will comprise approximately 12,000 lineal feet of embankment, extending from the southwesterly corner of the existing solid storage basins, to the southerly edge of the DLD site, and easterly along the southerly border of the DLD site. The exact alignment of the north-south trending portions of the embankment has not been determined; routes both easterly and westerly of an archeological site are being considered. An embankment crest elevation of approximately +117.5 feet (project datum) has been indicated. The resulting embankment height could be as great as 20 feet for portions westerly of the DLD site; embankment height would taper to less than 5 feet near Simms Road. Borings drilled in conjunction with the solid storage basin study (above) would be utilized for consideration of the lower portions of the embankment along the southerly border of the DLD site.

Seven additional borings, 30 to 40 feet in depth, would be drilled approximately 1000 feet on centers along the higher portions of the proposed embankment, westerly of the DLD site. Relatively undisturbed soil samples would be obtained from these borings and would be subjected to laboratory testing to define their engineering properties, principally strength and permeability parameters for the foundation soils beneath the higher portions of the embankment. Tests also would be performed on recompacted bulk samples.

Seepage and stability analyses would be performed on critical embankment sections. Following completion of field exploration, assemblage of data and engineering analysis, a formal report would be prepared containing a boring location plan, boring logs, and laboratory test results, as well as conclusions and recommendations regarding site preparation, including suggested earthwork specifications, embankment design and potential settlement.

We would initiate our field exploration program immediately following receipt of authorization to proceed. We estimate that approximately 3 weeks would be required for completion of the field program, provided the present dry weather conditions prevail. We would endeavor to complete our final report by November 15, 1978, assuming field exploration can be accomplished on schedule. We understand that 50 copies of each report would be required.

It is anticipated that both segments of the proposed study can be accomplished for a fee of approximately $19,500. Final billing would be determined in accordance with the attached schedule of fees for the work required.

Please sign the attached contract and return one copy of it and this letter as our written authorization to proceed. Any questions regarding this proposal or which may arise during the performance of our investigation should be addressed to me, as it is anticipated that I will be the Senior Engineer for our firm.

John M Raney
by JOHN M. RANEY
for LOWRY & associates

JMR:cll

Attachments: EPA Form 5700 (Pages 1 and 2)
EXHIBIT A - Accounting Methods
EXHIBITS B-1 and B-2 - Schedule of Fees for Soil & Foundation Engineering
EXHIBIT C - Overhead on Direct Labor
EXHIBIT D-1 - Summary of Direct Labor
EXHIBIT D-2 - Summary of Drill Rig Charges
EXHIBIT D-3 - Summary of Testing Charges
EXHIBIT D-4 - Summary of Other Charges

ATTACHMENT 3

Baier Agronomy, Inc.
ROUTE 2 • BOX 605 • WOODLAND, CALIFORNIA 95695 • PHONE (916) 662-6516

Mr. Allen K. Wolfenden
J. B. Gilbert & Associates
723 S Street
Sacramneto, CA 95814

August 24, 1978

Dear Al,

As you have requested, BAI is in the process of re-sampling the Sacramento DLD soils to deeper depths in an effort to verify the fate of certain sludge constituents. The sampling program consists of 42 samples per site taken at a depth of ten feet at twelve sites for a total of 504 samples. This is compared to a maximum of eight samples per site at twelve sites in the previous programs.

126 of the above samples will be analyzed for major ions. It is anticipated that this sampling and analytical work will be completed by September 30. A report revision to summarize and evaluate the data is expected by October 31.

Inasmuch as this is a substantial effort that was not contemplated in the original BAI budget, the attached cost estimate is submitted for your perusal.

Yours truly,

Dwight C. Baier

DCB:cb

ATTACHMENT 4

Contents

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Table 1. Direct Labor Summary

Grade	Adjusted Rate (dollars)	Hours	Cost (dollars)
Subtask 8.1			
10	19.48	80	1,558.40
14	12.90	280	3,612.00
16	9.92	380	3,769.60
34	7.12	100	712.00
64	7.12	110	783.20
Subtotal			10,435.20
Subtask 5.1			
10	19.48	10	194.00
16	9.92	300	2,976.00
34	7.12	100	712.00
64	7.12	100	712.00
Subtotal			4,594.00
Subtask 8.2			
13	14.41	20	288.20
14	12.90	10	129.00
29	14.41	45	648.45
31	11.34	43	487.66
32	9.92	240	2,380.80
33	8.36	264	2,207.04
34	7.12	1	7.12
35	5.92	15	88.80
37	4.00	17	68.00
40	9.92	14	138.88
Subtotal			6,443.95
Subtask 7.1			
10	19.48	25	487.00
14	12.90	366	4,721.40
16	9.92	96	952.32
34	7.12	12	85.44
65	5.92	87	515.04
Subtotal			6,761.20
Total Direct Cost			$28,234.35

Table 2. Other Direct Costs

Subtask	Description	Cost (dollars)
8.1	Travel	120.00
	Printing and expendable supplies	1.500.00
	Subtotal	1,620.00
5.1	Pilot surface spreading equipment	5,000.00
	Travel	250.00
	Printing and expendable supplies	1,000.00
	Subtotal	6,250.00
8.2	Equipment rental	1,720.26
	Special reporduction services	2,090.00
	Subtotal	3,810.26
7.1	Transportation, lodging	1,500.00
	Computer time	50.00
	Subtotal	1,550.00
Total Other Direct Costs		13,230.26

Table 3. Subcontractors

Subtask	Description	Cost (dollars)
8.1	Baier Agronomy, Inc.	1,000.00
	Lowry and Associates	19,500.00
	Eutek, Inc.	2,500.00
	Subtotal	23,000.00
5.1	Baier Agronomy, Inc.	7,500.00
	Subtotal	7,500.00
5.3	Baier Agronomy, Inc.	16,537.42
	Subtotal	16,537.42
Total Subcontractors		47,037.42

Table 4. Total Price by Subtasks

Subtask	Description	Cost (dollars)
8.1	Labor (direct + indirect)	28,071
	Other direct	1,620
	Subcontractors	23,000
	Profit	6,239
	Subtotal	58,930
5.1	Labor (direct + indirect)	12,358
	Other direct	6,250
	Subcontractor	7,500
	Profit	3,028
	Subtotal	29,136
5.3	Subcontractor	16,537
	Profit	670
	Subtotal	17,207
8.2	Labor (direct + indirect)	17,334
	Other direct	3,810
	Profit	3,474
	Subtotal	24,618
7.1	Labor (direct + indirect)	18,188
	Other direct	1,550
	Profit	3,473
	Subtotal	23,211
	Total Price	153,102

Table 5. Subtask 8.1 Manhour Summary

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM

TASK 8.1 - Site Planning and
Soils Investigation

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
I. Summary of SSB-DLD design criteria	10				10		20						30				20				
II. Development of and selection of viable SSB-DLD site plans	10				20		60														
III. Detail evaluation of alternative SSB-DLD site plans	20				110		145														
IV. Ash, grit, scum and screenings disposal	15				40		60														
V. Evaluation of alternative flood control levee alignments	5				20																
VI. Selection and description of recommended plan	20				80		80														
VII. Soil investigation-management							15														
													80				80				
TOTALS	80				280		380						110				100				

Table 6. Subtask 5.1 Manhour Summary

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM

TASK 5.1 - Feasibility Study of Surface
Sludge Spreading Systems

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
1. Acceptability						20															
2. Alternatives						40															
3. Pilot evaluation-distribution orifices						180															
4. Site configuration						20															
5. Report	10					40							100				100				
TOTALS	10					300							100				100				

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM

TASK 8.2 - Topographic Mapping of
SSB and DLD Sites

Table 7. Subtask 8.2 Manhour Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Analytical Photogrammetric Control											100										
Topographic Mapping				18							140	132									
Management-Coordination					10																
TOTALS				18	10						240	132									

MANHOUR SUMMARY
SACRAMENTO REGIONAL WASTEWATER MANAGEMENT PROGRAM

TASK 7.1 - SSMP EIR

Table 8. Subtask 7.1 Manhour Summary

TASK DESCRIPTION	PROFESSIONAL										TECHNICAL						CLERICAL				
	10	11	12	13	14	15	16	17	18	19	32	33	34	35	36	37	64	65	66	67	68
Informational Trips																					
April to 3 sites					36													8			
August to 2 sites					28													4			
Buffer Land Needs	3				50													8			
Engineering Analysis																					
Alternatives	8				150													30			
Recommended and Alternative Projects	8				30													10			
Implementation Schedule	4				40								12					15			
Solids Projection Update																					
Check BOD loads	2				16		40														
Run Computer Program					8		24														
Write Report					8		32											12			
TOTALS	25				366		96						12					87			

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS

(See accompanying instructions before completing this form)

Form Approved
OMB No. 158-R0144

PART I - GENERAL

1. GRANTEE
Sacramento Regional County Sanitation District

2. GRANT NUMBER
C-06-0938-010

3. NAME OF CONTRACTOR OR SUBCONTRACTOR
Sacramento Area Consultants

4. DATE OF PROPOSAL
November 6, 1978

5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)*

723 "S" Street
Sacramento, California 95814

6. TYPE OF SERVICE TO BE FURNISHED
Engineering services for the Sewage Sludge Management Program

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	**ESTIMATED HOURS**	**HOURLY RATE**	**ESTIMATED COST**	**TOTALS**
Proposed program revisions (see Attachment 4, Table 1)		$	$ 28,236.87	
DIRECT LABOR TOTAL:				$ 28,234.35
8. INDIRECT COSTS *(Specify indirect cost pools)*	**RATE**	**× BASE =**	**ESTIMATED COST**	
Proposed program revisions	1.69	$28,234.35	$ 47,716.05	
INDIRECT COSTS TOTAL:				$ 47,716.05
9. OTHER DIRECT COSTS				
a. TRAVEL			**ESTIMATED COST**	
(1) TRANSPORTATION			$	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$	
b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	**QTY**	**COST**	**ESTIMATED COST**	
Proposed program revisions (see Attachment 4, Table 2)		$	$ 13,230.26	
EQUIPMENT SUBTOTAL:			13,230.26	
c. SUBCONTRACTS			**ESTIMATED COST**	
Proposed program revisions (see Attachment 4, Table 3)			$ 47,037.42	
SUBCONTRACTS SUBTOTAL:			$ 47,037.42	
d. OTHER *(Specify categories)*			**ESTIMATED COST**	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 60,267.68
10. TOTAL ESTIMATED COST				$136,218.08
11. PROFIT				$16,883.99
12. TOTAL PRICE				$153,102.07

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES (*Indicate basis for price comparison*)	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☒ YES ☐ NO *(If "Yes" give name address and telephone number of reviewing office)*

Environmental Protection Agency
Sacramento Audit Office
Old Post Office Building
Sacramento, California 95814

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41-CFR 1 - 15.4

14c.

This proposal is submitted for use in connection with and in response to *(1)* acceptance of letter of 9/7/78 documenting proposed scope changes. This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* November 6, 1978 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) November 6, 1978
DATE OF EXECUTION

Lyle G Hoog
SIGNATURE OF PROPOSER

General Manager
Sacramento Area Consultants
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

16. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

ACCOUNTING METHODS

a) Our method of estimating proposed man hours is based upon our previous experience in the Sacramento area and the scope of work proposed in conjunction with Sacramento Area Consultants.

b) Our computation technique for arriving at the proposed labor rates are the estimated actual hourly rates to be paid during the proposed period. Individual time sheets will be maintained on a weekly basis to substantiate actual hours worked on the project.

c) Our factual source material used to develop the proposed man hours and labor rates were based upon our actual payroll records and job costs from our most recent fiscal year ended June 30, 1978.

d) Our actual payroll records and itemized expenses for indirect cost on direct labor includes payroll taxes, workmen's compensation insurance, actual idle time, sick leave, vacation and holidays paid. Also included in direct cost is time expended by principals during the course of any one project.

LOWRY & ASSOCIATES
GEOTECHNICAL ENGINEERS

SCHEDULE OF FEES FOR SOIL & FOUNDATION ENGINEERING

May, 1978

1. FIELD EXPLORATION

a. Test borings with undisturbed sampling, test probings or other exploration using drill rig and crew	$ 75.00 per hour
b. Test borings with undisturbed sampling, test probings using handsampling equipment and crew	55.00 per hour
c. Geophysical exploration: equipment plus crew	75.00 per hour
d. Rental equipment and labor	Cost plus 15%
e. Mileage (No charge for mileage under 50 miles round trip from Sacramento office)	0.30 per mile

2. LABORATORY TESTING

a. Moisture Content	6.00 each
b. Dry Unit Weight	7.50 each
c. Unconfined Compression	30.00 each
d. Direct Shear	
Undisturbed, Quick	40.00 each
Remolded, Quick	55.00 each
Undisturbed, Consolidated	50.00 each
Remolded, Consolidated	65.00 each
e. Triaxial Compression, quick, without pore pressure	
Undisturbed Specimens	50.00 each
Remolded	65.00 each
Other Types	Quotation on Request
f. Consolidation	150.00 each
g. Atterberg Limits	50.00 each
h. Expansion Index UBC 29-2	60.00 each
i. Shrinkage Limit	55.00 each
j. Permeability	
Undisturbed	80.00 each
Remolded	100.00 each
k. Grading Analysis	
Fine, including wash	30.00 each
Coarse	20.00 each
Hydrometer Analysis	55.00 each
l. Compaction Characteristics: Laboratory maximum density - optimum moisture	
ASTM D698	
Methods A & C	65.00 each
Methods B & D	80.00 each
ASTM D1557	
Methods A & C	80.00 each
Methods B & D	100.00 each
California Test Method No. 216	90.00 each

EXHIBIT B-1

m.	Resistance "R" Value, California 301	
	Untreated Samples	$ 85.00 each
	Laboratory Mixed Cement or Lime Stabilized Samples	110.00 each
n.	Associate Laboratory Services	Cost plus 15%

3. ENGINEERING & REPORT

a.	Technician	20.00 per hour
b.	Senior Technician	25.00 per hour
c.	Engineer/Geologist	40.00 per hour
d.	Project Engineer/Geologist	45.00 per hour
e.	Senior Engineer/Geologist	50.00 per hour
f.	Principal Engineer	60.00 per hour

OVERHEAD ON DIRECT LABOR
Per fiscal year ending June 30, 1978
(before wage increases of 7/78)

	Total as % of Direct Labor	Unallowable Costs as a % of Direct Labor	Allowable Costs as a % of Direct Labor
DIRECT LABOR:			
Salaries - direct only	$ 343,440		
SALARY OVERHEADS:			
Payroll Taxes			13.8
Paid Leave			27.6
Group Insurance			13.3
TOTAL SALARY OVERHEADS:	54.7		
GENERAL & ADMINISTRATIVE OVERHEADS:			
Indirect Salaries			70.9
Rental for Building & Equipment			12.7
Licenses for Insurance and Business Taxes			15.8
Travel & Subsistence			2.3
Field & Office Supplies			8.1
Professional Education, Dues and Subscriptions			2.4
Postage and Telephone			4.4
Depreciation			4.6
Legal & Accounting			5.2
Vehicle Expenses			6.9
TOTAL GENERAL & ADMINISTRATIVE:	133.3		
TOTAL ALLOWABLE EXPENSES:	188.0 %		
UNALLOWABLE EXPENSES:			
Interest Expense		5.1	
Entertainment		1.0	
*Operating Expenses excluded		34.1	
Profit Sharing		13.4	
TOTAL UNALLOWABLE EXPENSES:	53.6		

* Items excluded: Expenses for outside services, material & supplies, travel & subsistence on projects, reproductions and freight billed to clients.

SSB's AND PERIMETER EMBANKMENT

EXHIBIT C

SUMMARY OF DIRECT LABOR

Grade Code	Professional Status	Total Hours	Rate ($/hour)	Cost ($)
10	Principal	5	21.78	108.90
11	Senior Engineer	80	13.86	1108.80
14	Senior Draftsman	37	8.41	311.17
17	Technician	240	6.11	1466.40
	TOTAL			2995.27

SSB's AND PERIMETER EMBANKMENT

EXHIBIT D-1

SUMMARY OF DRILL RIG CHARGES
(labor not included)

Total Hours	Rate ($/hour)	Cost ($)
120	35	4200.00

SSB's AND PERIMETER EMBANKMENT

EXHIBIT D-2

SUMMARY OF TESTING CHARGES

Laboratory Testing	Quantity	Unit Price ($)	($)
Moisture content-dry density	100	13.50	1350.00
Compaction	4	80.00	320.00
Grain size	3	105.00	315.00
Atterberg limits	4	50.00	200.00
Remolded Permeability	4	100.00	400.00
Permeability	12	80.00	960.00
Unconfined compressive strength	5	30.00	150.00
Remolded triaxial compression	12	65.00	780.00
Consolidation	3	150.00	450.00
TOTAL			4925.00

SSB's AND PERIMETER EMBANKMENT

EXHIBIT D-3

SUMMARY OF OTHER CHARGES

Item	Cost ($)
Materials	22.45
Supplies	20.00
Reproduction	310.00
TOTAL	352.45

SSB's AND PERIMETER EMBANKMENT

EXHIBIT D-4

COST OR PRICE SUMMARY FORMAT FOR SUBAGREEMENTS UNDER U.S. EPA GRANTS *(See accompanying instructions before completing this form)*	*Form Approved* *OMB No. 158-R0144*

PART I - GENERAL

1. GRANTEE Sacramento Regional County Sanitation District	2. GRANT NUMBER C-06-0938-010
3. NAME OF CONTRACTOR OR SUBCONTRACTOR LOWRY & associates	4. DATE OF PROPOSAL October 5, 1978
5. ADDRESS OF CONTRACTOR OR SUBCONTRACTOR *(Include ZIP code)* 123 Commerce Circle P. O. Box 13340 Sacramento, CA 95813	6. TYPE OF SERVICE TO BE FURNISHED Geotechnical Engineering

PART II - COST SUMMARY

7. DIRECT LABOR *(Specify labor categories)*	ESTI-MATED HOURS	HOURLY RATE	ESTIMATED COST	TOTALS
Labor breakdown shown on Exhibit D-1,		$	$ 2995.27	
Summary of Direct Labor. Also see				
Exhibits B-1 and B-2, Schedule of Fees				
for Soil and Foundation Engineering				
DIRECT LABOR TOTAL:				$ 2995.27
8. INDIRECT COSTS *(Specify indirect cost pools)*	**RATE**	**× BASE =**	**ESTIMATED COST**	
See Exhibit C - Overhead on Direct Labor	1.88	$ 2995.27	$ 5631.11	
INDIRECT COSTS TOTAL:				$ 5631.11
9. OTHER DIRECT COSTS				
a. TRAVEL			**ESTIMATED COST**	
(1) TRANSPORTATION			$	
(2) PER DIEM			$	
TRAVEL SUBTOTAL:			$	
b. EQUIPMENT, MATERIALS, SUPPLIES *(Specify categories)*	**QTY**	**COST**	**ESTIMATED COST**	
Drill Rig - See Exhibit D-2	120	$ 4200.00	$	
Testing - See Exhibit D-3		4925.00		
Equipment, materials, supplies,				
reproduction - See Exhibit D-4		352.45		
EQUIPMENT SUBTOTAL:			9477.45	
c. SUBCONTRACTS			**ESTIMATED COST**	
			$	
SUBCONTRACTS SUBTOTAL:			$	
d. OTHER *(Specify categories)*			**ESTIMATED COST**	
			$	
OTHER SUBTOTAL:			$	
e. OTHER DIRECT COSTS TOTAL:				$ 9477.45
10. TOTAL ESTIMATED COST				$ 18103.83
11. PROFIT				$ 1396.17
12. TOTAL PRICE				$ 19500.00

687<

Form Approved
OMB No. 158-R0141

PART III - PRICE SUMMARY

13. COMPETITOR'S CATALOG LISTINGS, IN-HOUSE ESTIMATES, PRIOR QUOTES *(Indicate basis for price comparison)*	MARKET PRICE(S)	PROPOSED PRICE
		$

PART IV - CERTIFICATIONS

14. CONTRACTOR

14a. HAS A FEDERAL AGENCY OR A FEDERALLY CERTIFIED STATE OR LOCAL AGENCY PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER FEDERAL GRANT OR CONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If "Yes" give name address and telephone number of reviewing office)*

See Exhibit A

14b. THIS SUMMARY CONFORMS WITH THE FOLLOWING COST PRINCIPLES

41-CFR1-15.4

14c.

This proposal is submitted for use in connection with and in response to *(1)* SAC verbal request for proposal dated September 11, 1978. This is to certify to the best of my knowledge and belief that the cost and pricing data summarized herein are complete, current, and accurate as of *(2)* June 30, 1978 and that a financial management capability exists to fully and accurately account for the financial transactions under this project. I further certify that I understand that the subagreement price may be subject to downward renegotiation and/or recoupment where the above cost and pricing data have been determined, as a result of audit, not to have been complete, current and accurate as of the date above.

(3) October 9, 1978
DATE OF EXECUTION

SIGNATURE OF PROPOSER

President
TITLE OF PROPOSER

14. GRANTEE REVIEWER

I certify that I have reviewed the cost/price summary set forth herein and the proposed costs/price appear acceptable for subagreement award.

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

15. EPA REVIEWER *(If applicable)*

DATE OF EXECUTION

SIGNATURE OF REVIEWER

TITLE OF REVIEWER

FINAL REPORT
SOURCE SURVEY
PHASE I AND II

SEWAGE SLUDGE MANAGEMENT PROGRAM

September 18, 1979

Prepared for

Sacramento Area Consultants
Sacramento, California

By

Warren R. Uhte
SAC Project Manager

and

Allen K. Wolfenden
SAC Project Engineer

SACRAMENTO
AREA
CONSULTANTS

A JOINT VENTURE
BROWN AND CALDWELL
DEWANTE AND STOWELL
J.B. GILBERT & ASSOCIATES
THE SPINK CORPORATION

September 21, 1979

Mr. William N. Anderson
Sewage Sludge Management Program
9660 Ecology Lane
Sacramento, California 95827

J231G

SEWAGE SLUDGE MANAGEMENT PROGRAM
FINAL TASK REPORT
SOURCE SURVEY, PHASE I AND II

Submitted herewith is the Phase I and II report of the Sewage Sludge Management Program Source Survey. The Phase I report was prepared in accordance with subtasks E, F, and G of the 1976 Revised Work Plan and Proposal of the Sewage Sludge Management Program (SSMP) as revised December 10, 1976, by Sacramento Area Consultants. The Phase II report was prepared in accordance with an extension of subtask G of May 30, 1978, Recommended Program Revisions for the SSMP.

The purpose of this report is to determine which existing treatment plants within the Sacramento Regional County Sanitation District are receiving excessive levels of heavy metals and chlorinated hydrocarbons.

Phase I Report

A comparison of the heavy metal loads in the raw sludges of the ten sampled plants revealed that Northeast, Highland Estates, CSD #6, and Meadowview receive only domestic levels of heavy metals. The loads entering these plants were then compared to the other six plants to determine which heavy metals and chlorinated hydrocarbons were being discharged to these plants in levels in excess of domestic contributions. The average daily metal loads from monitored industries were then compared to the total influent load at the appropriate treatment plant to determine the relative importance of the currently monitored industries as heavy metal sources.

In conclusion, the Phase I report summarizes those plants that are receiving excessive levels of heavy metals and chlorinated hydrocarbons, identifies potential sources of some of these discharges, and makes recommendations for the work that should be included in Phase II of the Source Survey.

Phase II Report

The purpose of the Phase II report is to present the analyses of selected stored daily samples of City Main influent and effluent and Central raw sludge. City Main influent and effluent daily samples were analyzed to verify that the concentration of nickel and lead increased through the City Main treatment process. Central raw sludge was analyzed to determine if the peak cadmium concentration in the raw sludge was from a single slug discharge.

The scope of the Phase II report was reduced from that which was proposed at the conclusion of the Phase I report due to the promulgation of National Pretreatment Standards. Compliance with these standards will require implementing all of the recommendations made in the Phase I report plus much more. Therefore, only the stored samples were analyzed and the remainder of the work deferred until the District develops the mandated Pretreatment Program.

For SRCSD, provisions of the Construction Grants Program require that the District have an approved Pretreatment Program before the final 10 percent payment will be made on the Phase II Solids Processing and Disposal grant. A preliminary schedule for implementing the Pretreatment Program, such that an approved Pretreatment Program is obtained prior to the final 10 percent payment on the Phase II Solids Processing and Disposal Grant, is presented.

We are prepared to answer any questions on this report or the pretreatment regulations.

SACRAMENTO AREA CONSULTANTS

Warren R Uhte
Warren R. Uhte
Project Manager

Allen K. Wolfenden
Allen K. Wolfenden
Project Engineer

AKW:ch

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CHAPTER 1

INTRODUCTION

This source survey was conducted as part of the Sewage Sludge Management Program. This chapter contains background information related to the scope of the survey, the organization of the report, the authorization of the work and recognition of those who assisted in its conduct.

Scope of Work

The Sewage Sludge Management Program (SSMP) Source Survey, Phase I was designed to determine which existing treatment plants within the Sacramento Regional County Sanitation District (SRCSD) are receiving excessive levels of heavy metals and chlorinated hydrocarbons.[1] The survey was divided into three subtasks. The goals of these subtasks are as follows:

1. Collect and analyze raw sludge samples from ten District-supervised wastewater treatment plants to determine if any of the plants have higher than normal levels of heavy metals or chlorinated hydrocarbons.

2. Collect and analyze influent and effluent samples from the City Main and Central wastewater treatment plants to establish whether influent and effluent levels of metals and organics can be related to the raw sludge levels determined in Task 1; this task was also intended to obtain information on plant removal efficiency of metals and organics.

---

[1] Chlorinated hydrocarbons includes polychlorinated biphenyls (PCB).

3. Based on review of data from Tasks 1 and 2, determine which treatment plants are receiving abnormally high levels of either heavy metals or chlorinated hydrocarbons. Also, compare the heavy metal and chlorinated hydrocarbons concentrations to other municipalities as found in a literature search.

Phase I of the SSMP Source Survey was designed to determine if there are significant sources of nondomestic toxic material discharges to the SRCSD sewer system. If desirable, stored daily samples can be analyzed to further determine concentration and characteristics of toxic materials discharges.

Based on the Sacramento County Industrial Waste Section (IWS) Local Source Survey, an estimate is made of the quantity of toxic materials discharged from currently monitored industries. Recommendations are made on whether to expand surveillance to include additional industries or whether currently monitored industries appear to be the principal sources.

Report Organization

The report is divided into six chapters:

1. Introduction

2. Source Survey Procedures and Analytical Results

3. Heavy Metals in Domestic Wastewaters

4. Analysis of Treatment Plant Raw Sludge and Influent Data

5. Comparisons of SSMP Source Survey Results to Other Surveys and Standards

6. Summary and Recommendations

Chapter 2 describes the sampling program which includes descriptions of sampled plants, sample collection frequency, sample times, sample collection points, and characteristics of samples. Analytical techniques, which are as prescribed by the EPA, and the results of heavy metals and chlorinated hydrocarbons analyses are summarized.

Chapter 3 presents the rationale for developing an estimated domestic heavy metal concentration in raw sludges. This approach is used to establish baseline concentrations to which mixed industrial-domestic sludges can be compared.

Chapter 4 compares the concentrations of heavy metals and chlorinated hydrocarbons observed at the Central and City Main treatment plants to the estimated domestic concentrations. This comparison readily identifies those heavy metals that are being discharged in excessive levels to the respective collection systems. Although an estimated domestic level concentration of chlorinated hydrocarbons was not developed, the quantities and characteristics of the discharges to Central and City Main are presented.

Chapter 5 presents a comparison of the SSMP Source Survey results to data obtained from the Sacramento County IWS Local Source Survey, other municipalities and applicable standards.

Chapter 6 presents a summary and recommendations for further study.

Authorizations

This report was prepared in accordance with subtasks 3.1, 3.2 and 3.3 similarly described as subtasks E, F and G of the February 17, 1976 Revised Work Plan and Proposal of the Sewage Sludge Management Program (SSMP) as revised December 10, 1976 by Sacramento Area Consultants.

Acknowledgments

Appreciation is hereby expressed to the District personnel who aided in this study. The treatment plant operating staffs are thanked for their consciencious effort in collecting transporting and storing daily raw sludge and wastewater samples, the personnel of the Industrial Waste Section for supplying information on the industries within the SRCSD, and the District Control Lab and the City Main lab personnel for sample storage and review of the analytical data.

CHAPTER 2

SOURCE SURVEY PROCEDURES AND ANALYTICAL RESULTS

The SSMP Source Survey has been divided into three subtasks. Subtask 1, identified as J231E, was to sample and analyze raw sludges at ten Sacramento Regional County Sanitation District (SRCSD) treatment facilities. Subtask 2, identified as J231F, was to sample and analyze influents and effluents at the Central and City Main plants. Subtask 3, identified as J231G, was to report the findings of Subtasks 1 and 2. The sampling program and analytical procedures are described in this chapter.

Sample Collection Procedures

Raw sludges were sampled at ten SRCSD wastewater treatment plants: Northeast, Rancho Cordova, Arden, Highland Estates, Rio Linda, CSD #6, Natomas, Central, Meadowview, and City Main. In addition, influent and effluent samples were collected at Central and City Main.

Sludge samples, where possible, were raw primary sludge. Variations in treatment processes and sludge disposal methods affected the quality and quantity of raw sludge that could be sampled at each plant. Table 2-1 describes for each plant the treatment process, sludge disposal system, type of sludge, sample point, sludge characteristics and collection frequency. Table 2-2 describes the influent and effluent sampling procedure including sample points and method of sample collection.

Three different types of sample bottles were used. Samples collected for heavy metals analysis were stored in plastic bottles, while samples for chlorinated hydrocarbons analysis were stored in glass bottles. Raw sludge and influent samples were collected in

Table 2-1. Sludge Sample Collection

Facility name	Treatment process components	Sludge disposal system	Sludge type sampled	Sample point	Sludge sample characteristics	Days and time samples collected
Northeast	Primary sedimentation Aeration Secondary sedimentation Digestion	Export to Central	Raw primary only	No. 2 sludge pump	Good representative sample	Sunday-Saturday 11:00 p.m.
Rancho Cordova	Primary sedimentation Spiral mixing Supernate filter Secondary sedimentation	Export to Central	Raw primary only	Centrifugal sludge pump	Thin; due to continuous pumping to export line	Sunday-Saturday 11:00 a.m.
Arden	Aeration Secondary sedimentation Trickling filter	Export to City Main	W.A.S. from secondary clarifier	Centrifugal Sludge pump Sludge pump room	Thin; W.A.S. and secondary sludge	Sunday-Saturday 1:00 p.m.
Highland Estates	Primary sedimentation Bio-filter Secondary sedimentation Digestion	Sludge drying beds	Raw primary and bio-filter, humus ratio 1/1	Raw sludge pump (When operating)	Good representative sample	Monday, Wednesday, Friday 1:00 p.m.
Rio Linda	Primary sedimentation Aeration Sedimentation Oxidation Digestion	Sludge drying beds	Raw primary and return activated sludge	Sludge pump	Good representative sample	Monday-Thursday 12:00 noon Friday 8:30 a.m.
CSD #6	Primary sedimentation Trickling filter Secondary sedimentation Trickling filter	Export to Northeast	Raw and trickling filter	Centrifugal export pump	Thin; sample taken only when clarifier scrapper passes sump	Monday-Friday 3:00 p.m.
Natomas	Primary sedimentation Ponds Digestion	Discharge to ponds	Raw primary only	Piston sludge pump	Good representative sample	Monday and Wednesday 10:00 a.m. Friday 8:00 a.m.
Central	Primary sedimentation Aeration Secondary sedimentation Digestion	S.S.B.'s D.L.D.	Raw primary only	Raw sludge pump	Good representative sample	Sunday-Saturday Grab:6/day Composited
Meadowview	Primary sedimentation Trickling filter Secondary sedimentation	Exports to City Main	Raw primary and filter humus ratio 1/1	Raw sludge pump	Good representative sample	Sunday-Saturday 10:00 a.m.
City Main	Primary sedimentation Bio-filters Secondary sedimentation Digestion	Vacuum filter Land fill	Raw and bio-filter humus ratio 1/1	Raw sludge pump	Good representative sample	Sunday-Saturday Grab: 4/day Composited

Table 2-2. Influent and Effluent Sample Collection

Facility name	Treatment process components	Discharge point	Influent sample		Effluent sample	
			Sample point	Collection procedure	Sample point	Collection procedure
Central	Primary sedimentation Aeration Secondary sedimentation Digestion	Sacramento River	Headworks	24-hour composite sampler	Reclaimed water pump	Grab: 12/day composited
City Main	Primary sedimentation Bio-filters Secondary sedimentation Digestion	Sacramento River	Headworks	24-hour composite sampler	Upstream end of outfall	24/hour composite sampler

one-pint bottles of either glass or plastic, and effluent samples for heavy metal analysis were collected in five-pint plastic bottles. Five-pint bottles were used for effluents in order to have a larger sample volume due to the anticipated lower heavy metal concentrations in the effluent. Effluent samples for chlorinated hydrocarbons analysis were collected in the same one-pint glass bottles. No preservatives were used except for continuous sample refrigeration after collection.

Each daily sample was stored under refrigeration until the end of the week. Each day's sample for each plant was then composited into a weekly composite which was submitted for analysis.

From each plant, five samples of raw sludge were submitted for analysis representing the sludge from five weeks. Similarly, influent and effluent samples were collected daily at Central and City Main, composited into weekly samples, and submitted for analysis. The remainder of each daily sample was placed in freezer storage for subsequent analysis, if necessary.

Analytical Procedures

Each raw sludge, influent and effluent sample was analyzed for the following: arsenic, beryllium, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, silver, zinc and chlorinated hydrocarbons.[1]

Analytical procedures for heavy metals were as prescribed by EPA in "Preliminary Sampling and Analytical Procedures for Evaluating the Disposal of Dredge Materials." In sample preparation for heavy metal analysis, each sample was digested in concentrated nitric acid and hydrogen peroxide (30 percent) and then analyzed for the array of heavy metals by atomic absorption.

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[1] Appendix D presents the complete list of chlorinated hydrocarbons analyzed for which includes PCB's.

Chlorinated hydrocarbons samples were extracted by repeated partitioning into 15 percent dichloromethane in hexane. The extracts were cleaned upon a florisil column, and chlorinated hydrocarbons were detected by gas-liquid chromotagraphy (GLC), using an electron capture detector. The method is that defined by EPA, "Method for PCB's in Industrial Effluents MDQARL," EPA, Cincinnati.

Results

Average concentrations of each constituent at each facility for the five weeks sampled are presented in Table 2-3 and 2-4. Those results are analyzed and discussed in the succeeding chapters. The complete analytical results for each week are presented in Appendices A and B.

Table 2-3. Heavy Metals Concentrations (Averages for five weeks)

Treatment facility		Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc
		Concentration in raw sludge, mg/kg											
Northeast		7.76	N.D.[a]	2.8	24.8	99	22	2.1	N.D.	12.1	0.55	9.1	414
Rancho Cordova		12.1	N.D.	3.0	10.0	104	27	0.8	N.D.	25.3	1.26	5.7	254
Arden		7.9	N.D.	5.4	54.6	202	19	4.8	N.D.	25.8	1.42	42.6	560
Highland Estates		6.1	N.D.	4.1	47.2	168	25	2.9	N.D.	18.2	1.52	1.9	556
Rio Linda		14.2	N.D.	9.7	91.4	358	52	5.6	N.D.	38.2	1.56	10.8	1,264
C.S.D. #6		4.7	N.D.	3.6	23.2	119	22	2.2	N.D.	20.0	0.50	3.3	382
Natomas		53.8	N.D.	3.5	35.4	104	24	1.2	N.D.	23.6	0.76	2.1	414
Central		16.2	N.D.	28.9	114.8	196	70	3.7	N.D.	46.4	1.07	18.0	622
Meadowview		5.9	N.D.	3.1	22.4	126	24	3.1	N.D.	18.0	0.63	3.0	422
City Main		16.2	N.D.	0.5	230	326	92	5.1	N.D.	103.8	1.39	62.4	858
		Concentration in influent and effluent, mg/l											
Central	Influent	0.0036	N.D.	N.D.	0.02	0.08	0.07	0.0006	N.D.	0.09	0.0008	<0.01	0.20
	Effluent	0.0019	N.D.	N.D.	0.004	0.02	0.04	0.0001	N.D.	0.08	0.0001	N.D.	0.07
City Main	Influent	0.0038	N.D.	N.D.	0.03	0.06	0.04	0.0009	N.D.	0.08	0.0003	0.004	0.14
	Effluent	0.0029	N.D.	N.D.	0.02	0.03	0.04	0.0009	N.D.	0.24	0.0002	0.006	0.06

[a] N.D. - not detected.

Table 2-4. Chlorinated Hydrocarbon Concentrations (Averages for five weeks)

Treatment facility		Polychlorinated biphenyls #1254	Polychlorinated biphenyls #1242	Aldrin	Hexachlorobenzene	Lindane	Methoxychlor	Technical chlordane
		Concentration in raw sludges, mg/kg						
Northeast		0.32	N.D.[a]	N.D.	N.D.	0.12	N.D.	0.52
Rancho Cordova		N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Arden		N.D.	N.D.	N.D.	0.48	0.2	N.D.	1.78
Highland Estates		N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Rio Linda		2.1	N.D.	N.D.	N.D.	N.D.	N.D.	5.5
C.S.D. #6		0.4	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Natomas		0.3	N.D.	N.D.	N.D.	N.D.	N.D.	0.84
Central		1.76	N.D.	N.D.	0.14	N.D.	N.D.	2.76
Meadowview		0.98	N.D.	N.D.	N.D.	N.D.	N.D.	0.12
City Main		3.06	N.D.	N.D.	N.D.	N.D.	N.D.	15.3
		Concentration in influent and effluent, µg/l						
Central	Influent	0.18	N.D.	N.D.	0.05	0.24	N.D.	1.24
	Effluent	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.08
City Main	Influent	N.D.	N.D.	N.D.	N.D.	0.02	0.08	2.38
	Effluent	N.D.	N.D.	N.D.	N.D.	N.D.	0.02	0.90

[a] N.D. - not detected.

CHAPTER 3

HEAVY METALS IN DOMESTIC WASTEWATERS

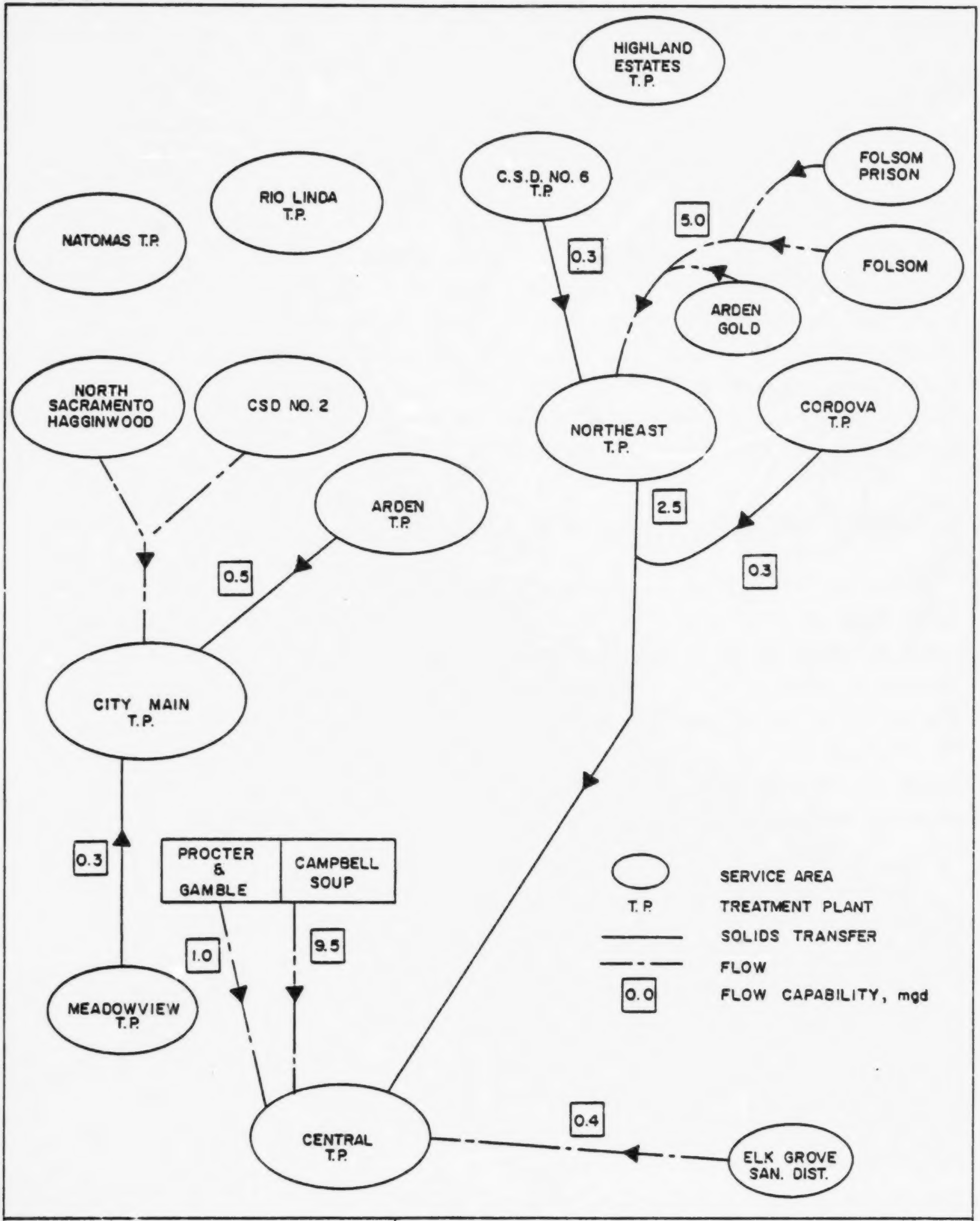
The estimated domestic unit loads are developed in the first section of this chapter and verified by comparisons with other District studies and information from other sewerage agencies. These domestic values are used to develop theoretical domestic heavy metal loads to the Central and City Main treatment plants. These estimated domestic loads are compared to the measured loads at Central and City Main in Chapter 4.

Estimate of Heavy Metals in SRCSD Domestic Sludges

Concentrations of heavy metals in domestic wastewaters in SRCSD have been characterized by the observed concentrations in the raw sludges from Northeast, Highland Estates, CSD #6, and Meadowview treatment facilities. There are no significant industrial dischargers in these service areas except Technicolor which discharges to Northeast. The wastes discharged to these plants are predominantly residential plus associated commercial, such as retail stores, restaurants, car washes, gas stations, and laundries.

Figure 3-1 shows the flow and sludge transfers that occur within the entire SRCSD collection system. Because of these interconnections of the collection systems, it is difficult to make a direct comparison of toxic material concentrations from a known domestic area to an industrialized area.

To evaluate each system on a uniform basis, the total in milligrams per day mass of toxic materials entering each facility was computed as follows:



SCHEMATIC OF INTERPLANT FLOWS AND SOLIDS TRANSFERS

JBGA/AKW/MAD 12/77 FIGURE 3-1

Calculation:

$$(\text{lb/day-suspended solids})^{1} (0.4536 \text{ kg/lb})(\text{mg/kg})^{2} = \text{mg/day}$$

Where:

1. Suspended solids from plant records

2. Concentration (mg/kg = ppm) from laboratory analysis

Assumption:

Heavy metals and chlorinated hydrocarbons are predominately associated with suspended solids in sewage. Therefore, measurement of quantities in raw sludges will provide a reasonable estimate of total quantity entering plant. This assumption and exceptions to it are discussed in Chapter 4.

Volume of daily sludge production could be substituted for influent suspended solids load and might provide a more accurate basis for the calculation of metals load. Unfortunately, only Central and City Main have reliable sludge pumpage data. Therefore, to provide a consistent base for comparison of all ten plants, total influent suspended solids was used. At Central and City Main the relationship between the estimated total mass of heavy metals entering the plants based on total suspended solids and sludge pumpage volume was compared. This comparison indicated that total mass as calculated, based on influent suspended solids, was 15 to 30 percent higher than the estimate based upon sludge pumpage data. This difference results in a slightly higher estimate of domestic loads but does not signficantly affect the conclusions. The daily loads developed from the influent suspended solids were then converted to unit loads by dividing total milligrams per day by the tributary population. This unit load expresses the heavy metal contribution from a domestic service area on a basis which can be used for analyzing data from industrial-domestic areas.

The average per capita unit loads for the five weeks for each heavy metal in each facility are presented in Table 3-1. From this table, those facilities which had consistently low concentrations of the heavy metals were assumed to represent a domestic sludge. These included Northeast, Highland Estates, CSD #6 and Meadowview treatment plants. A range of unit domestic loads (Table 3-2) was developed from data for the weekly composite raw sludge samples collected at these four treatment plants. The top of the range was defined by the highest concentration in any weekly composite from any of the four domestic treatment plants. Similarly, the low value for each metal was selected from the lowest concentration of the weekly composites. The average was flow weighted. Since Northeast comprises 85 percent of the total ADWF from these four plants, the average closely represents the per capita heavy metal contributions within the Northeast treatment plant service area. The range of domestic unit loads is used to compute the estimated range of domestic heavy metal loads at City Main and Central treatment plants. The estimated domestic heavy metal load at Central and City Main is in turn compared to the measured loads in Chapter 4.

Comparison of SRCSD Domestic Metal Concentrations to Other Sewerage Agencies

In the literature, heavy metal levels in domestic wastewater are usually expressed as influent concentrations. Typically, these domestic loads are obtained by sampling a major trunk or pump station serving a residential area. Since the domestic loads presented in Table 3-2 are based on heavy metal concentrations in raw sludges, it is not possible to directly compare the values. A rough comparison can be made but it requires some significant assumptions of the percentages of each heavy metal removed in primary sedimentation. Insufficient data were available to make such assumptions with confidence; therefore, the comparisons were not attempted.

Table 3-1. Average Heavy Metal Loads

Heavy metal	Unit loads (mg/capita/day)									
	Northeast	Rancho Cordova	Arden	Highland Estates	Rio Linda	CSD #6	Natomas	Central	Meadowview	City Main
Arsenic	0.52	1.84	0.69	0.27	2.07	0.40	5.74	1.41	0.29	2.49
Beryllium	N.D.[a]	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cadmium	0.19	0.46	0.47	0.19	1.42	0.30	0.37	2.51	0.15	1.61
Chromium	1.67	1.52	4.79	2.12	13.3	1.96	3.78	9.97	1.11	35.3
Copper	6.65	15.82	17.79	7.53	52.3	10.1	11.1	17.0	6.22	50.1
Lead	1.48	4.12	1.67	1.12	7.59	1.86	2.56	6.08	1.18	14.1
Mercury	0.14	0.12	0.42	0.13	0.82	0.19	0.13	0.32	0.15	0.78
Molybdenum	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nickel	0.81	3.85	2.26	0.82	5.57	1.69	2.52	4.03	0.83	15.9
Selenium	0.04	0.19	0.12	0.07	0.23	0.04	0.08	0.09	0.03	0.21
Silver	0.61	0.87	3.74	0.09	1.58	0.28	0.22	1.56	0.14	9.58
Zinc	27.8	38.64	49.14	24.92	184.5	32.3	44.2	54.02	19.46	131.7

[a] N.D. - not detected.

Table 3-2. Range of Unit Heavy Metal Loads

Heavy metal	Unit loads[a] (mg/capita/day)		
	High	Average	Low
Arsenic	0.54	0.5	0.17
Beryllium	N.D.[b]	N.D.	N.D.
Cadmium	0.77	0.2	0.09
Chromium	2.28	1.7	0.88
Copper	10.2	7.0	6.58
Lead	3.05	1.5	0.49
Mercury	0.25	0.15	0.10
Molybdenum	N.D.	N.D.	N.D.
Nickel	2.28	0.9	0.50
Selenium	0.13	0.04	N.D.
Silver	0.67	0.6	0.04
Zinc	38.1	27.7	18.3

[a] Range based on high week and low week from either Northeast, Highland Estates, CSD #6 or Meadowview. Average is flow weighted.

[b] N.D. - Not detected.

A comparison was made between the heavy metal concentrations, as measured in the IWS Local Source Survey, to concentrations reported by other sewerage agencies as presented in Table 3-3. Most of the influent concentrations measured at Northeast, Highland Estates, CSD #6, and Meadowview fall within the ranges for domestic sewage as reported by other agencies.

Table 3-3. Ranges of Heavy Metal Concentrations in Domestic Wastewaters

Communities	Concentrations (μg/l)								
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
Los Angeles County (La Canada)[a]	14	5	20	119	51	0.5	31		490
New York City:[b]									
67th Road		2	70	110			10		240
New Douglaston		7	150	330			80		370
Aqueduct		5	3	150			10		150
24th Avenue		1	9	190			10		130
75th Avenue		2	35	200			10		130
Avenue M		1	8	230			150		300
City of Los Angeles California[c]		20	50	70	100	1.4	80	10	270
Orange County California[c]		10	8	101	45	0.6	53	2	240
San Diego California[c]	5	8	25	181	34	1.3	86	9	690
La Cresenta California[c]	1	24	13	61	154	3.0	136	19	
Simi Valley California[c]	2	12	40	101	79	1.5	86	24	320
Unidentified California[c]			35	380	100		180	50	450
New York City[c]		3	46	202			45		220
Wisconsin[c]		16		110	140	1.0	73		340
Queens, New York[c]		16	90	210			90		250
Pittsburg, Pennsylvania[c]		13	22	.12	75		14		200
Muncie, Indiana[c]		7	8	120	120		24		250
Sacramento Co.[d]									
Northeast	3	2	14	80	42	2.4		8	190
Highland Estates	2	54	55	53	63	3		37	180
CSD #6	1	2	10	140	36	0.4		3	260
Meadowview	3	13	46	42	34	2		9	98

[a] Eason, J.E., Kremer, J.G., Dryden, E.D., "Progress in the Sanitation Districts Industrial Waste Source Control Program" presented at California Water Pollution Control Association Conference, April 29, 1977.

[b] Klein, L.A. et al. "Source of Metals in New York City Wastewater." Journal Water Pollution Control Fed., Vol. 46, 2653 (1974).

[c] State Water Resources Control Board, "Staff Proposal for Amendments to Table B of the Ocean Plan." Draft, September, 1976.

[d] Sacramento Regional County Sanitation District," Industrial Waste Section, Local Source Control Program", January-June 1977.

CHAPTER 4

ANALYSIS OF TREATMENT PLANT RAW SLUDGE AND INFLUENT DATA

The City Main and Central treatment plants receive the sludge from 97 percent of the sewered population within the SRCSD boundary. Graphs presented on Figures 4-1 through 4-11, presented in subsequent sections, provide summaries of detected heavy metals discharged to the City Main and Central collection systems. These graphs compare the total load, as calculated from the influent concentration and from the raw sludge concentration, to an estimated domestic level. The domestic range is based on the total population tributary to the collection system and the unit domestic loads developed in Chapter 3. These graphs indicate whether the heavy metals or chlorinated hydrocarbons were detected in widely varying concentrations or of relatively uniform concentrations over the five weeks survey period.

On each figure three values are presented: the estimated domestic range, the total load as measured in the influent, and the total load as measured in the sludge. Several factors should be kept in mind when reviewing the figures. The relationship between the total influent heavy metal load and the quantity retained in the raw sludge varies with the metal. Arsenic, cadmium, chlromium, copper, mercury, silver, and zinc are predominately associated with the particulate and colloidal fractions of the sewage. Nickel and lead, on the other hand, are typically found in higher concentrations in the soluble form. The data collected at Central and City Main and as reported in the literature support this observation. It was found that an average of 80 percent of the nickel and 60 percent of the lead entering Central and City Main treatment plants was in the soluble form; therefore, comparisons should be made between the total influent load as calculated from the raw sludge data to the estimated domestic load as opposed to comparing the total influent load as calculated from the influent concentrations to the estimated domestic load.

The relationship between the quantity of plant flow and tributary population affects the estimated domestic load. The domestic range for each plant has been calculated based on the sludge tributary population. In the case of City Main, this approach tends to underestimate the domestic heavy metal load since the City Main plant serves large commercial and transient populations. It is possible to account for this variable, though, by approximately doubling the high value of the "domestic range" as presented on Figures 4-1 through 4-11. In comparison to the magnitudes of metals detected, though, this does not materially affect the conclusions.

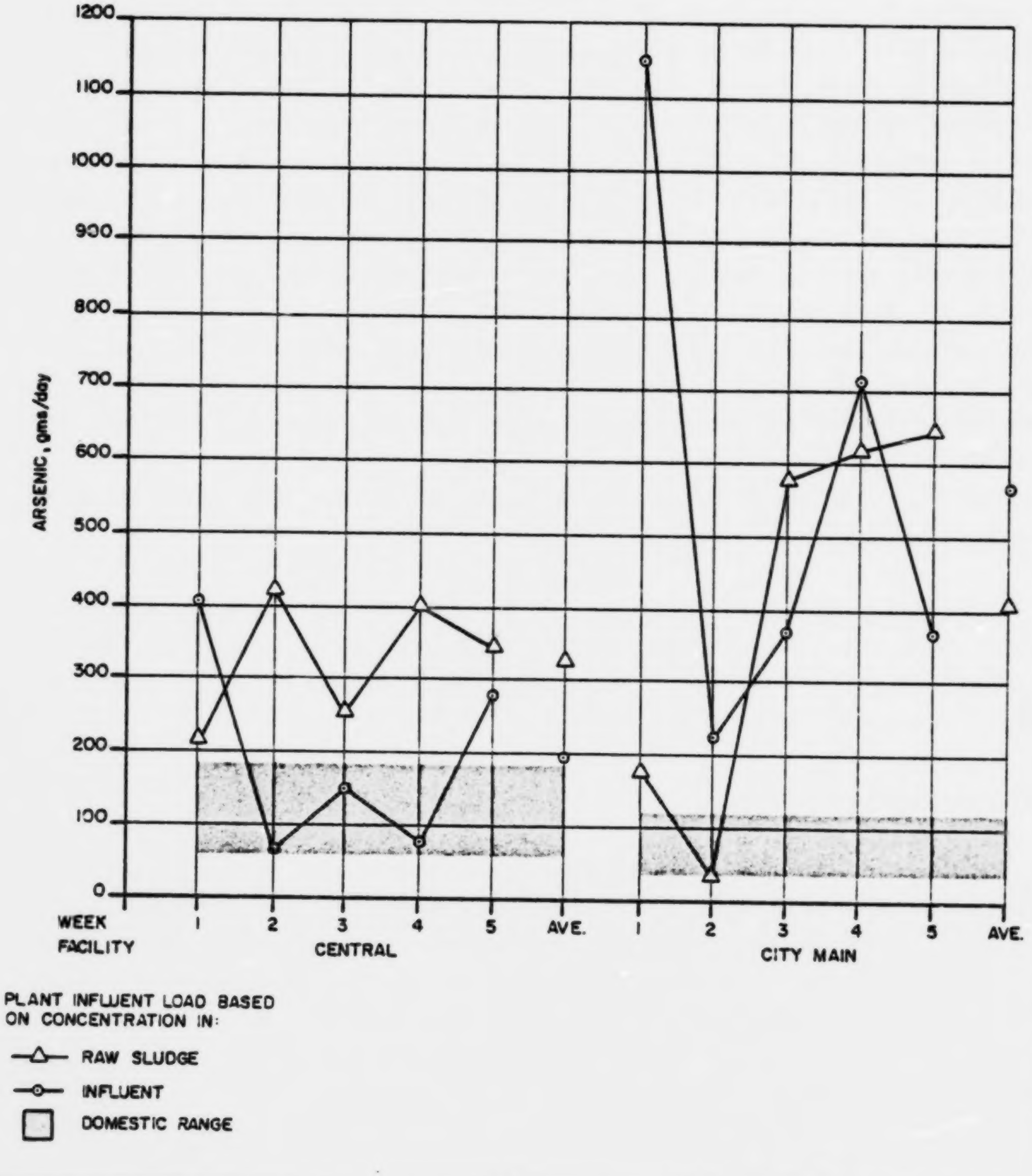
HEAVY METALS AT CENTRAL AND CITY MAIN

The following sections and accompanying figures describe the quantities and characteristics of the heavy metals discharged to the Central and City Main tributary areas. Figures are not presented for beryllium, molybdenum or selenium. Beryllium and molybdenum were not detected in either raw sludge or influent samples. Selenium was only sporadically detected and always in extremely low concentrations.

Arsenic (Figure 4-1)

Central. Arsenic discharges to Central were not significantly greater than estimated domestic levels.

City Main. Arsenic discharges to City Main varied considerably and were significantly higher than domestic levels during several weeks. These fluctuations may have been the result of a periodic, potentially controllable discharge.



	ARSENIC
JBGA/AKW/MAD 10/77	FIGURE 4-1

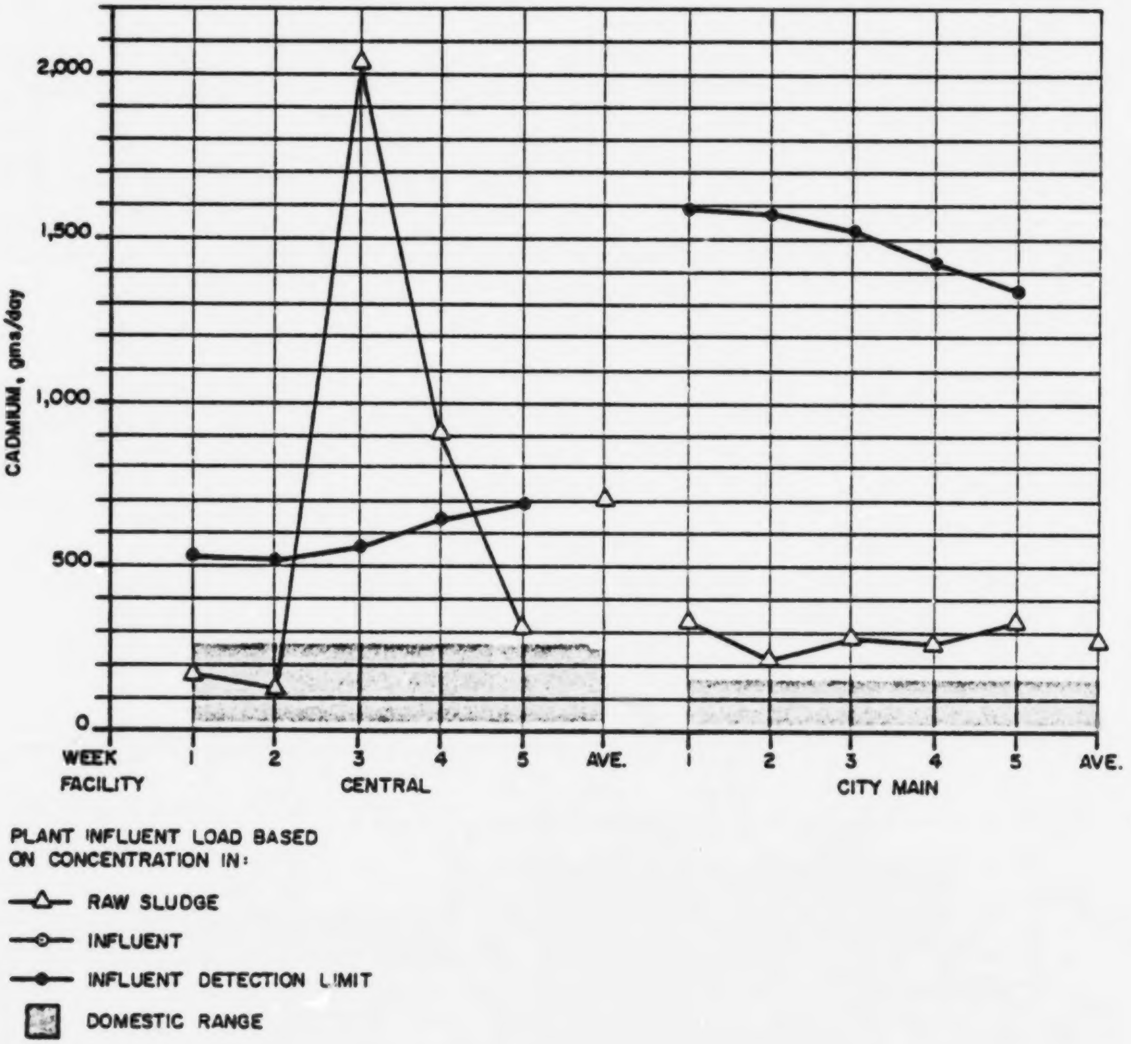
Cadmium (Figure 4-2)

Central. Cadmium discharged to Central fluctuated from a domestic level to high level and then declined. This type of fluctuation indicates a potential, periodic point source. An extremely high level of cadmium (1.2 mg/l) (Appendix C) was detected by the District in the Rancho Cordova influent. This load could have contributed to the Central levels since Rancho Cordova sludge is tributary to the Central treatment plant. Another contributing source could be Campbell Soup Company. The District's IWS Local Source Survey detected 0.038 mg/l of cadmium in the Campbell Soup wastewater flow. With a discharge of 4 to 5 mgd during the sampling period, this could have accounted for a total of 700 grams/day of cadmium. Additional analysis of the daily stored samples would indicate if the higher values observed in weeks 3 and 4 were due to one or two days of extremely high concentrations or a lower, consistent discharge for the two-week period.

City Main. Cadmium concentrations in the City Main influent were less than the detection limits of the test procedure. Quantities detected in the sludge were characteristic of a domestic level discharge.

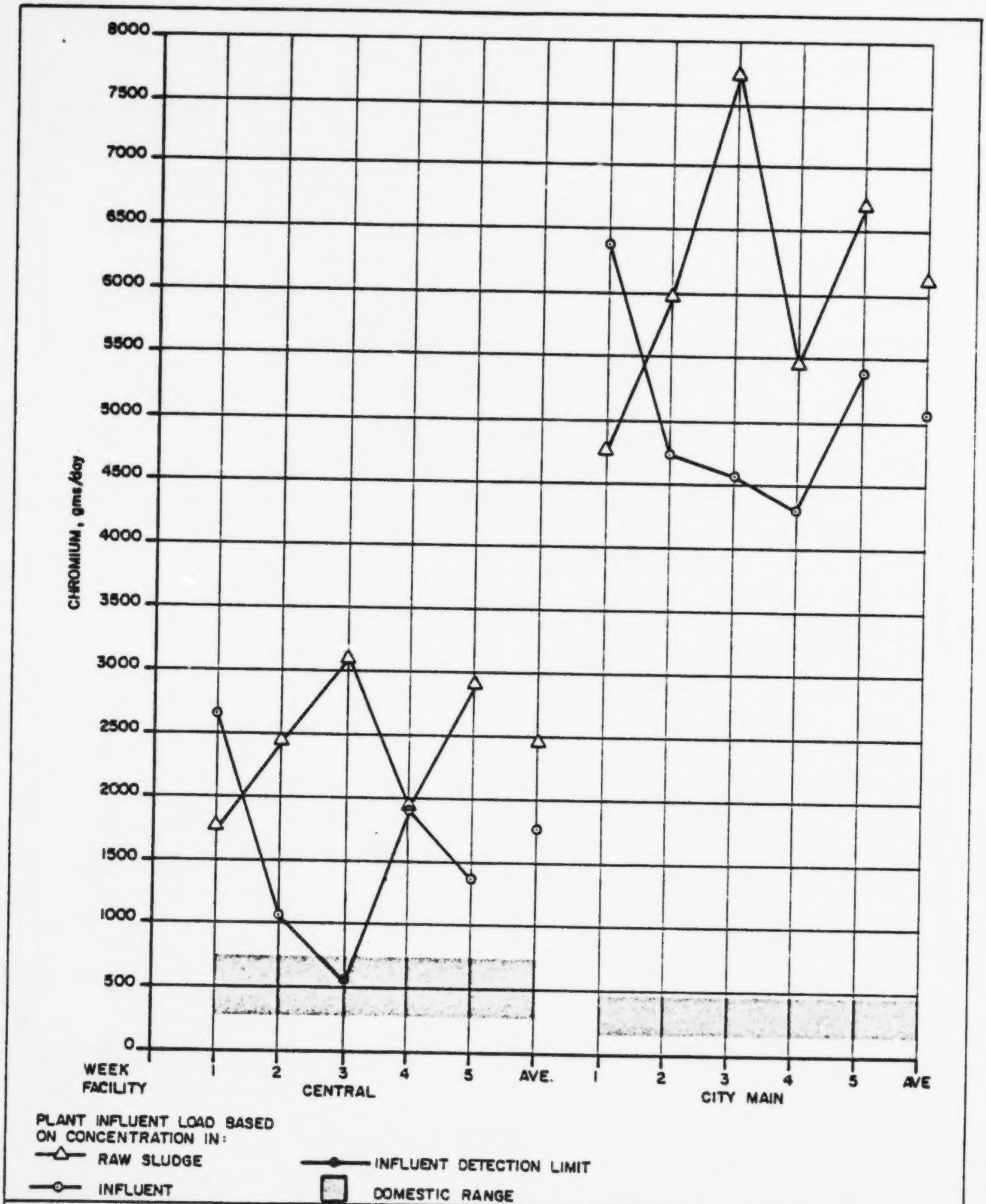
Chromium (Figure 4-3)

Central. Chromium discharges to Central were greater than the estimated domestic level. The chromium load was relatively constant, indicating a continuous major source or several relatively low-level sources. The influent concentration in week 3 dropped within the domestic range, but this reduction in the chromium load was not reflected in the raw sludge concentration, and is not deemed significant.



CADMIUM

JBGA/AKW/MAD 10/77 FIGURE 4-2



CHROMIUM

JBGA/AKW/MAD 10/77 FIGURE 4-3

City Main. Chromium discharges to City Main were very high with substantial peaks. The chromium load is more than ten times that expected for a strictly domestic wastewater. Plating industries, several of which exist in the City Main service area, and the Western Pacific and Southern Pacific freight yards and repair shops are suspected sources.

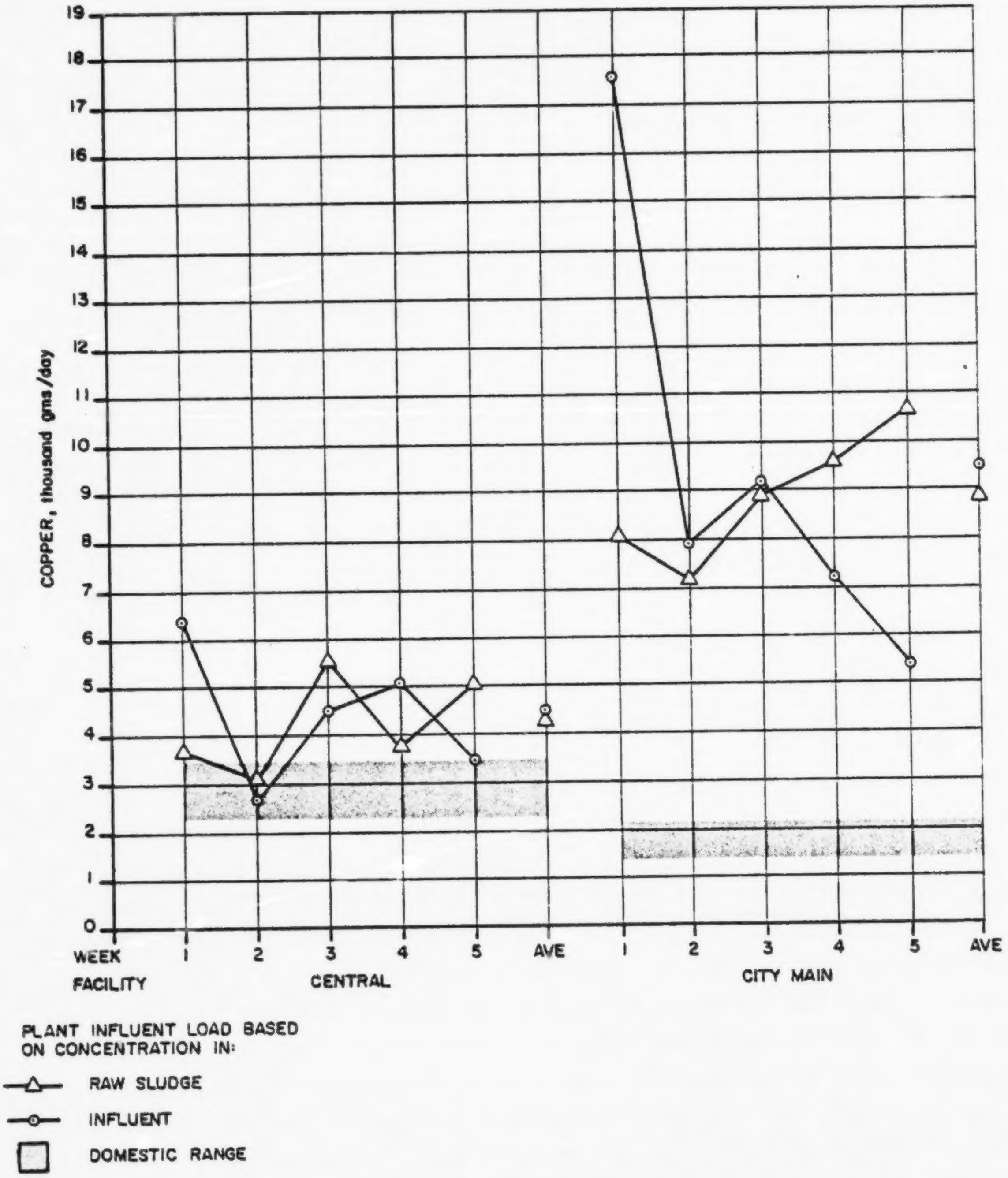
Copper (Figure 4-4)

Central. Copper discharges to Central were not significantly greater than domestic levels, as indicated by both raw sludge and influent load estimates.

City Main. Copper discharges to City Main were far in excess of estimated domestic levels. Weekly correlation between raw sludge concentrations and influent was very poor in three out of five cases, although the five-week averages were very close. The high concentrations measured indicate a nondomestic copper source.

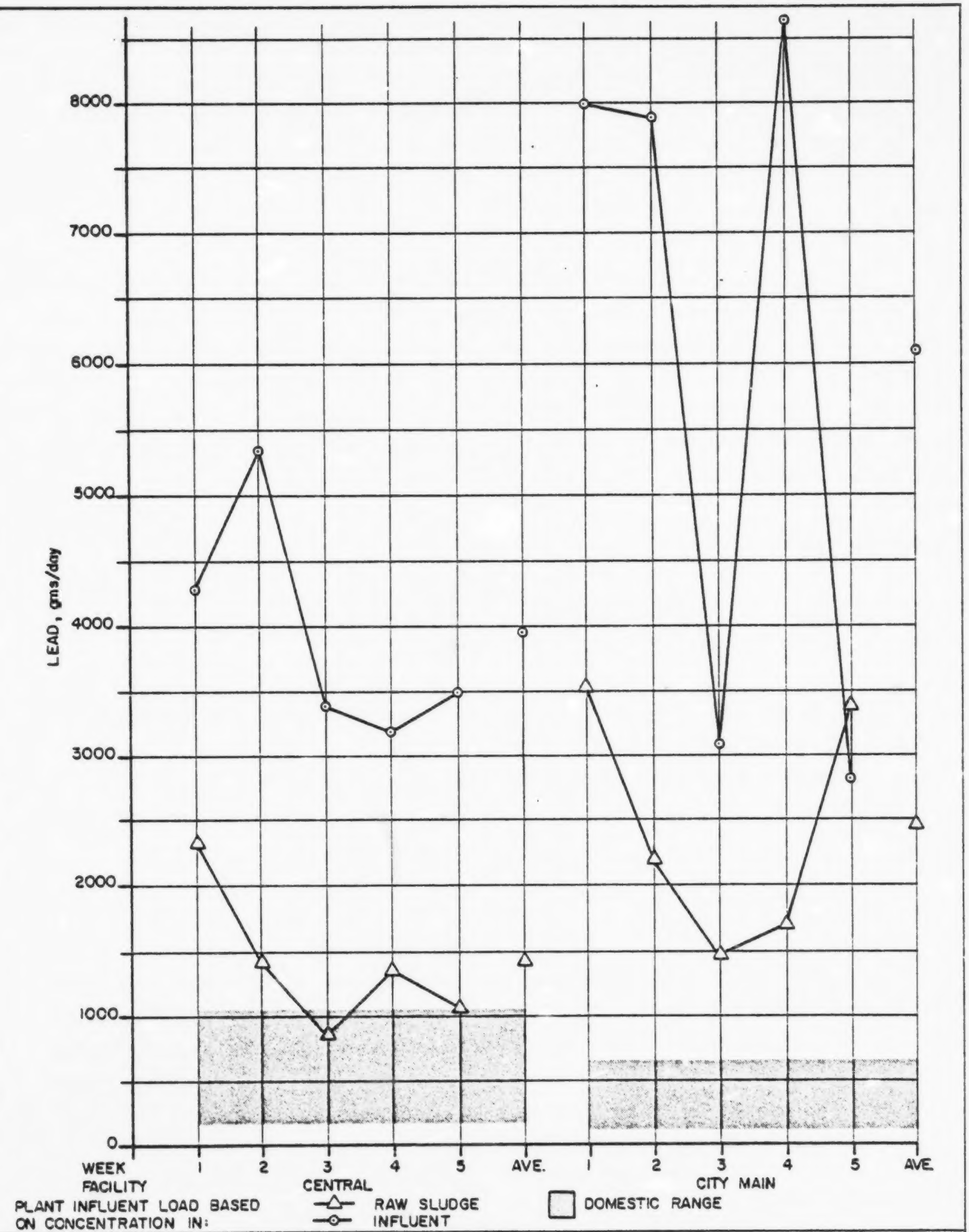
Lead (Figure 4-5)

Central. Discharges of lead to Central were not significantly greater than the estimated domestic levels based on raw sludge concentrations. However, the loads based on influent concentrations apparently indicate a discharge far in excess of a domestic level. As previously discussed, lead appears to have less affinity for the organic matter, and colloidal fractions in the sewage, therefore, would appear in a lower concentration in a raw primary sludge. This was evident by comparing the difference in detected levels of lead in both the City Main and Central influents and raw sludges. Only 40 percent of the lead detected in the influent was detected in the raw sludge. It should be noted, however, that the domestic level projection was based upon concentrations of lead found in the raw sludges of Northeast, Highlands Estates, Meadowview and CSD #6 treatment plants. Therefore, the discrepancy



COPPER

JBGA/AKW/MAD 10/77 FIGURE 4-4



LEAD

JBGA/AKW/MAD 10/77 FIGURE 4-5

723<

between the total load detected in the raw sludges and that detected in the influent is not critical. Comparison of the total lead load in the raw sludge with the estimated domestic level indicates that Central lead levels were essentially at the domestic level.

City Main. Discharges of lead to City Main are substantially in excess of domestic levels. Again, the discrepancy between the influent and sludge concentrations should limit one's comparison to estimated domestic loads versus the load measured in the raw sludge. The raw sludge curve indicates a periodic discharge of some magnitude which is generally mirrored in the variation of the influent load.

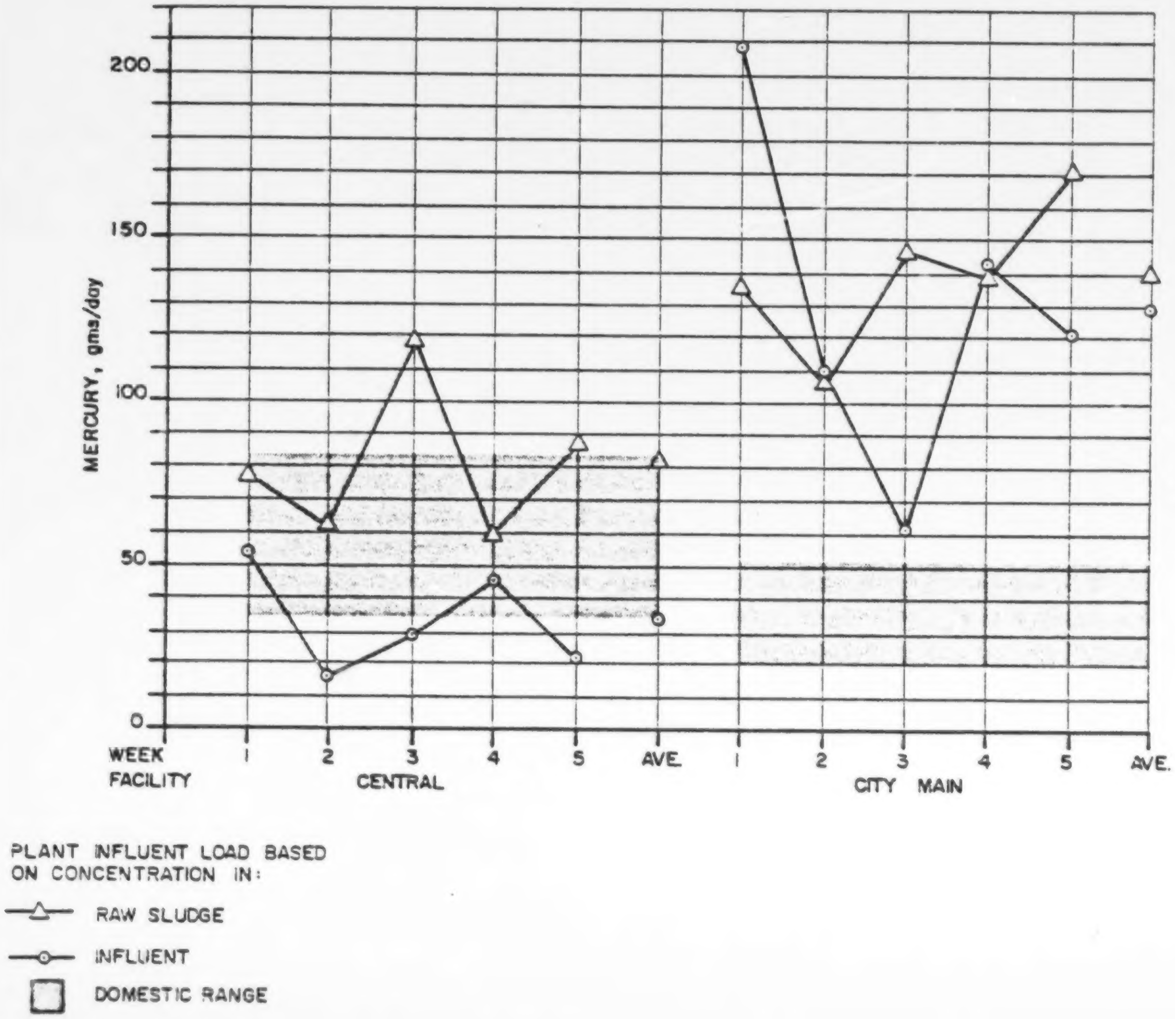
Mercury (Figure 4-6)

Central. Mercury discharges to Central were in the range of the estimated domestic level discharge.

City Main. Mercury discharges to City Main were moderately in excess of projected domestic levels. The apparent random fluctuation between the influent and raw sludge concentrations make it difficult to draw any conclusions about the nature of the discharge.

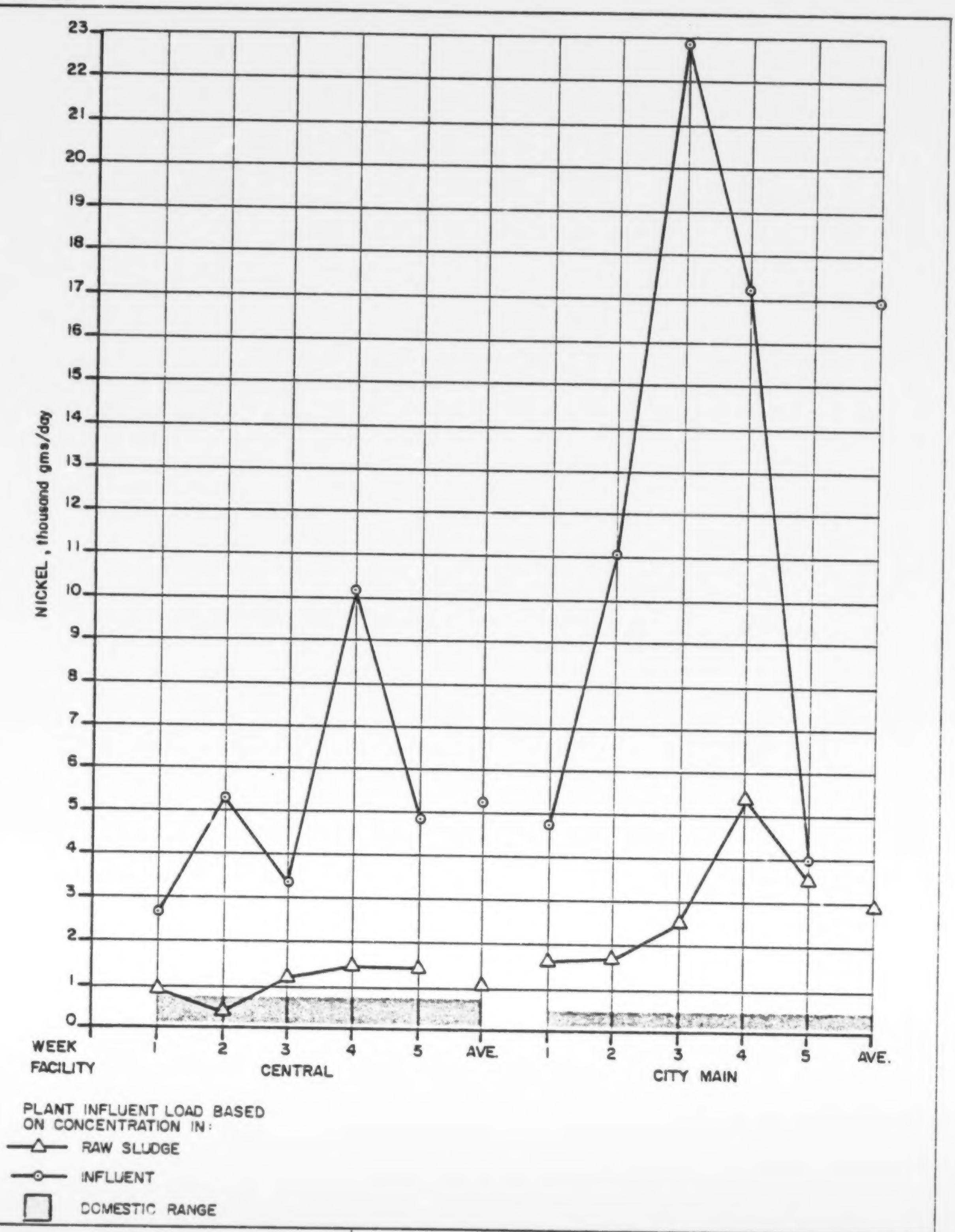
Nickel (Figure 4-7)

Central. Nickel discharges to Central were in the range of the estimated domestic level discharge, based on the load derived from sludge data. Nickel, like lead, differs widely in the amount found in the influent and the quantity found in the raw sludge. The detectable peaks in the influent concentration, however, suggest there may be a periodic, low level point source.



MERCURY

JBGA/AKW/MAD 10/77 FIGURE 4-6



NICKEL

JBGA/AKW/MAD

10/77

FIGURE 4-7

City Main. Nickel discharges to City Main were far in excess of a projected domestic level. The extreme increase in influent concentration in week 3 suggests a large point source discharge. Although not as pronounced, another peak occurred during the fourth week of sludge sampling.

Silver (Figure 4-8)

Central. Silver discharged to Central, based on sludge concentrations, was not significantly in excess of the estimated domestic levels; influent concentrations were below the detection limits of the test.

City Main. Silver discharges to City Main were in excess of a projected domestic level discharge. The discharge appeared to be fairly constant, suggesting a continuous uniform discharge to the collection system.

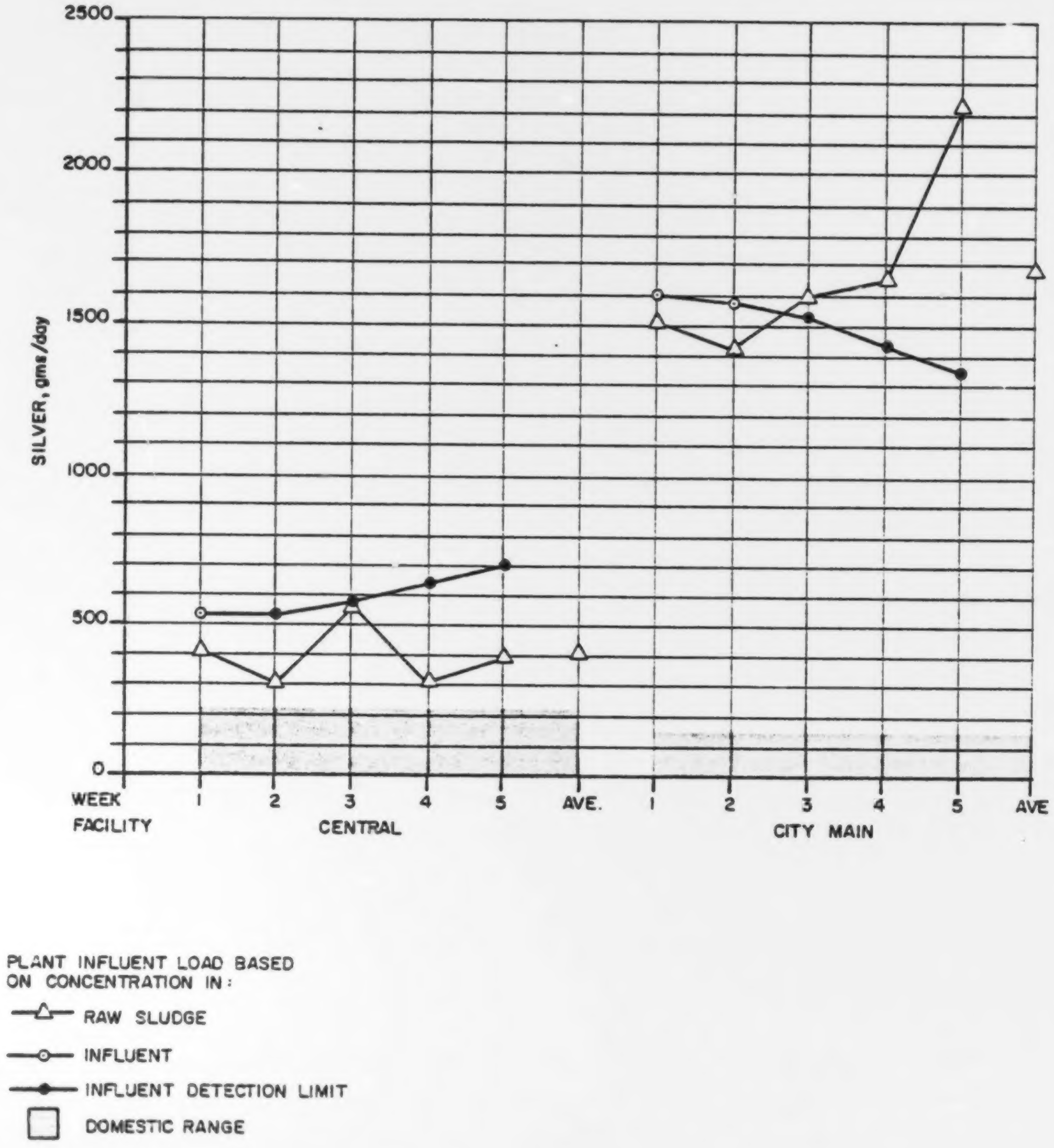
Zinc (Figure 4-9)

Central. Zinc discharges to Central were within the range of projected domestic wastewater.

City Main. Zinc discharges to City Main were moderately in excess of projected domestic level discharges.

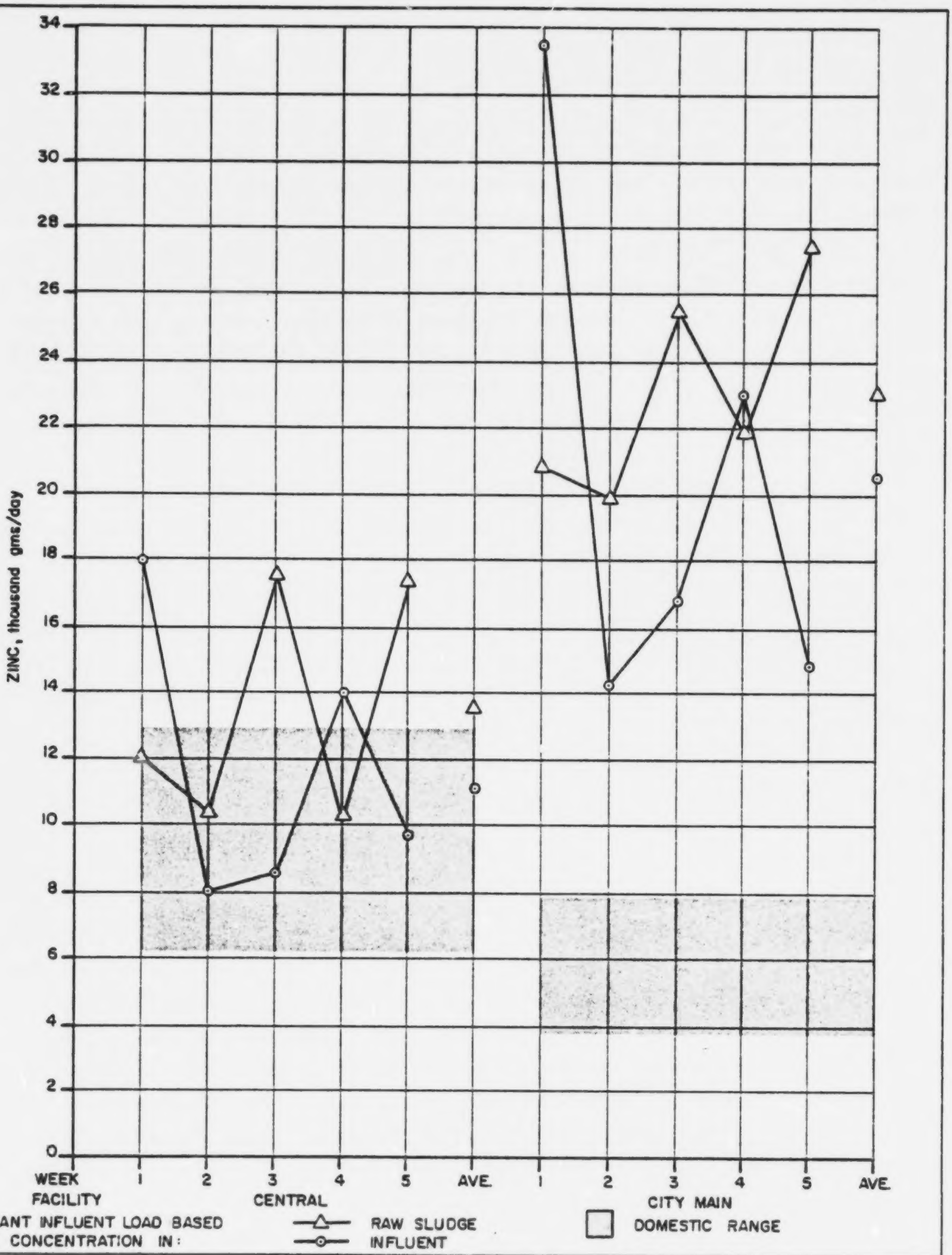
CHLORINATED HYDROCARBONS

Sludge samples were analyzed for chlorinated hydrocarbons by spectrographic techniques. Only a few hydrocarbons were detected with some consistency and at levels of interest in this study.



SILVER

JBGA/AKW/MAD 10/77 FIGURE 4-8



ZINC

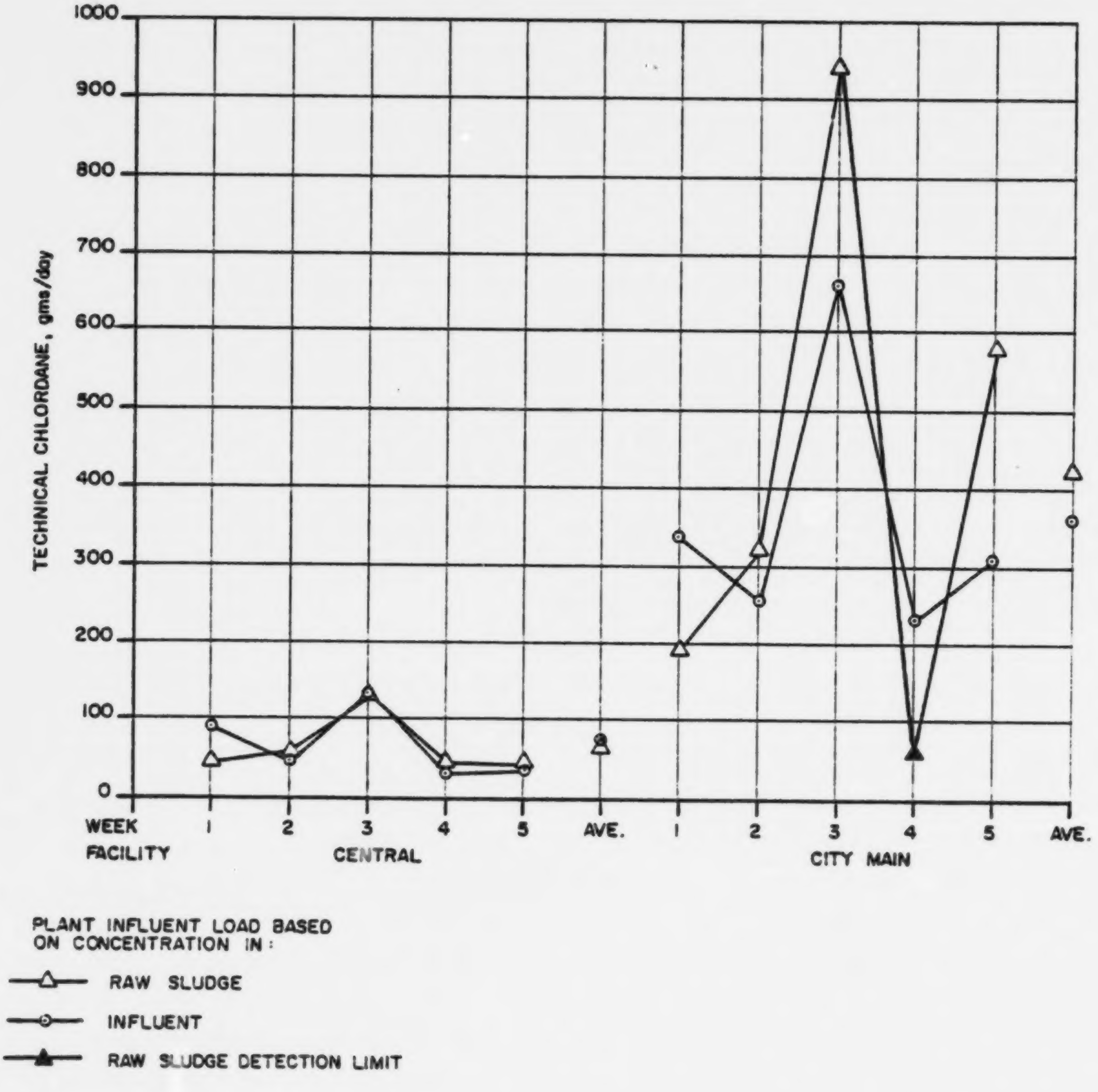
JBGA/AKW/MAD 10/77 FIGURE 4-9

Chlorinated Hydrocarbon Pesticides

Because of the extremely low concentrations of pesticides encountered, it was not possible to compute a domestic level in the manner used in the heavy metal evaluation. For example, reviewing the data for chlordane, which was the most consistently detected pesticide, indicated that it was not detected at all in three treatment facilities (Rancho Cordova, Highland Estates and CSD #6) and only in one week out of five at the Northeast and Meadowview treatment facilities. It is, therefore, concluded that a domestic level discharge is less than the detection limits of 0.0001 mg/l.

Central. Technical chlordane (Figure 4-10) was detected in the raw sludges and influent in each of the five weekly samples. Very small quantities of hexachlorobenzene, lindane and methoxychlor were also periodically detected in the raw sludges and influents. Chapter 5 presents comparisons of Proposed Primary Drinking Water Standards for chlorinated hydrocarbons with measured concentrations at Central and City Main. All pesticides detected at Central were in concentrations less than those recommended in the EPA Proposed Drinking Water Standards. Also of note is the excellent correlation of total load as measured in the raw sludge and influent. Similarly, in City Main the correlation is also good for chlordane.

City Main. Technical chlordane was detected in the raw sludge and influent at varied levels. On only one of the five weeks did the level exceed the Proposed Primary Drinking Water Standards. Lindane was detected on two of the five weeks and methoxychlor on one week only and, again, these levels were substantially below the Proposed Primary Drinking Water Standards. The fluctuation and magnitude of the discharge indicates that there are periodic discharges of chlordane to the collection system not readily accounted for from domestic sources.



	TECHNICAL CHLORDANE		
	JBGA/AKW/MAD	10/77	FIGURE 4-10

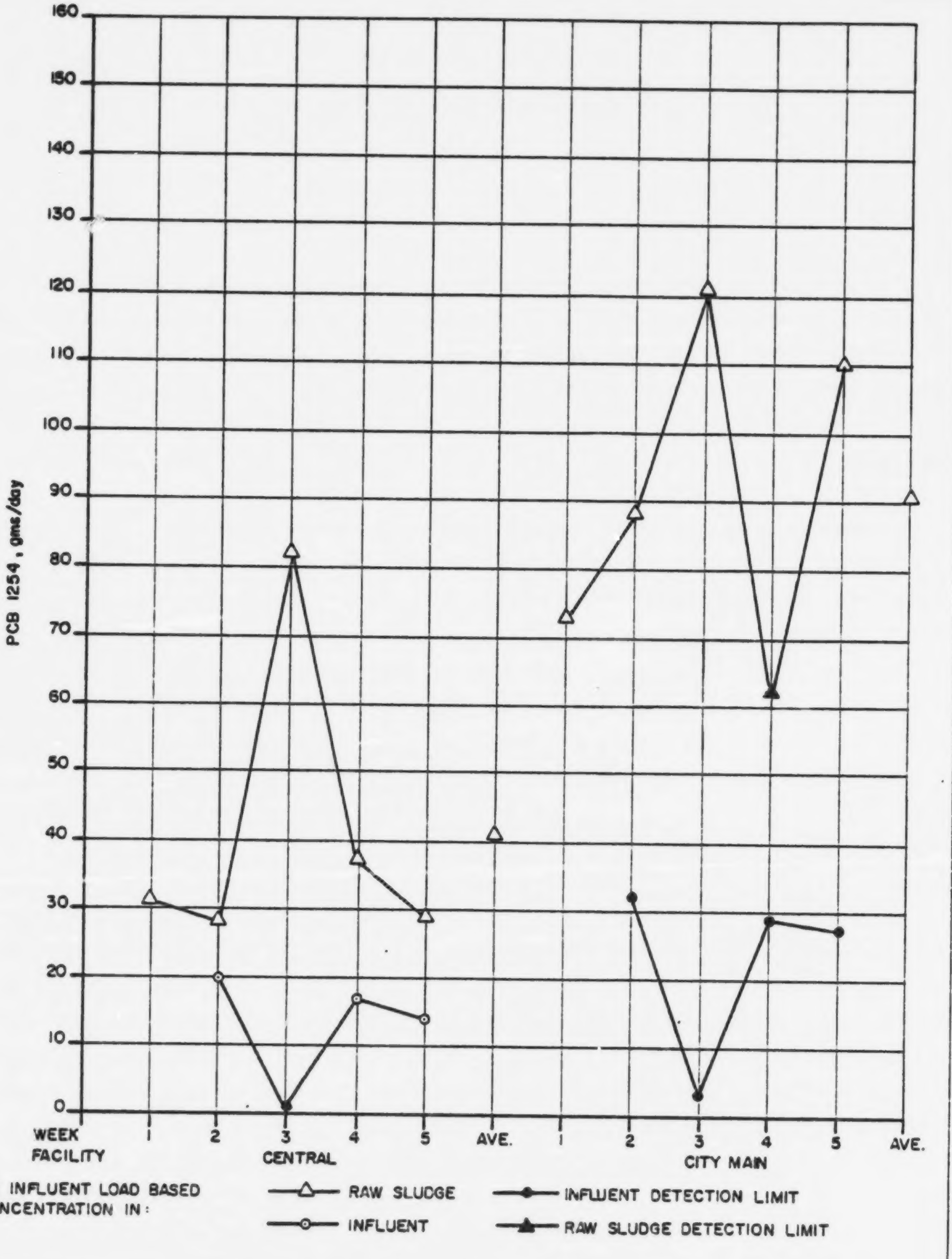
Polychlorinated Biphenyls

Polychlorinated biphenyls (PCB's) were not detected in the raw sludges in three treatment facilities (Rancho Cordova, Arden and Highland Estates) and were detected in only one of the five weeks of samples for the Northeast, CSD #6 and Natomas treatment plants (see Figure 4-11). Samples for Meadowview, which were consistently low in all heavy metals and pesticides, contained detectable levels of PCB #1254 on two of the five weeks sampled. It is assumed that a domestic level discharge is below the detection limits of 0.0002 mg/l.

Generally, for the heavy metals analyzed, total load estimates were lower when calculated based on the raw sludge concentration. This is to be expected since, depending on the particular heavy metal, varying percentages of the total influent mass is in the soluble form and not associated with the particulate matter. The portions in solution were not detected in the raw sludge samples. However, the data collected in this survey indicate substantially higher levels of PCB's in the raw sludges than in the influent. This suggests that PCB's are closely associated with the organic and colloidal fractions of the sewage.

Central. Relatively constant low level concentrations of PCB 1254 were found in the raw sludge, with two of the five weeks of influent samples dropping below the detection limits. Based on the detectable concentrations in the raw sludge for the five weeks sampled, after digestion and storage in the SSB's, this sludge would qualify as Class I sludge as defined by the California State Health Department in their "Proposed Regulations on Handling Disposal and Application to Land of Sewage Solids," November 1976.

City Main. Fluctuating levels of PCB 1254 were detectable in raw sludge and influent samples. Again, these levels are less than that specified for a Class I sludge as described above.



PCB 1254

JBGA/AKW/MAD 10/77 FIGURE 4-11

OTHER TREATMENT PLANTS

Arden

Silver was the only heavy metal detected in a significantly elevated concentration, while chromium was somewhat above the domestic range. All the other heavy metals were not significantly in excess of estimated domestic concentrations.

Natomas

Arsenic was the only heavy metal having significant concentrations in excess of the estimated domestic level. This excessive concentration, however, was only detected during one week of the five sampled. The samples for the remaining four weeks contained concentrations less than the estimated domestic level. Chromium was also detected slightly in excess of the estimated domestic level. None of the other heavy metals were detected in levels significantly greater than the estimated domestic level.

Rio Linda

Rio Linda sludge showed significantly elevated concentrations of all heavy metals for all of the weeks measured. Significantly elevated levels of PCB 1254 were also detected on two of the five weeks measured, and consistently elevated concentrations of chlordane were detected in all five of the weekly samples. There are no known industrial discharges to the Rio Linda collection system. The Rio Linda area is characterized as a diverse mixture of homes and small ranches with numerous small backyard industries. A battery recycling facility was the suspected source of the heavy metals. This source, however, was investigated by the Sacramento County Industrial Waste Section and found not to be discharging to the sewer system.

If the Regional Plant were on line today, the quantities of cadmium, copper and zinc from Rio Linda would account for only 0.5, 1.4 and 1.8 percent, respectively, of the total heavy metal load to the treatment facility. Although the concentrations in the Rio Linda sludge are seemingly high, the actual loads do not represent a major source of heavy metals in the Regional System. If a point source in Rio Linda is found, it would be desirable to control it. However, if the sources are found to be many and diverse, controls may not be practical.

HEAVY METAL REMOVALS AT CENTRAL AND CITY MAIN

Percent removals were calculated based upon measured influent and effluent concentrations. Average influent and effluent grams per day loads and percent removals are presented in Table 4-1.

Percent removals at Central are consistent with expected heavy metal removals from an activated sludge plant. Lead and nickel percent removals at Central are consistent with the ratio of each metal found in raw sludges and influent as shown on Figures 4-5 and 4-7. Percent removals at City Main indicate either very poor removals for several metals, sampling or analytical errors, or additions of heavy metals during the treatment process. Nickel and lead are of particular interest. The influent and effluent analyses indicate that there was more lead and nickel being discharged than in the influent. Potential sources of these metal additions are being analyzed. Ferric chloride which is used as a sludge conditioning chemical for vacuum filtration has several heavy metals as contaminants. Analysis of ferric chloride by the Orange County Sanitation Districts revealed significant and varied concentrations of heavy metals. Table 4-2 presents the results of these analyses.

Analyses are currently being done on the filtrate from the vacuum filters at the City Main treatment plant to determine if heavy metals were being added to the treatment process.

Table 4-1. Heavy Metal Removals at Central and City Main

Heavy metal	Central			City Main		
	Influent gms/day	Effluent gms/day	Percent removal	Influent gms/day	Effluent gms/day	Percent removal
Arsenic	193	106	45	567	452	20
Beryllium	N.D.[a]	N.D.		N.D.	N.D.	
Cadmium	N.D.	N.D.				
Chromium	1,753	N.D.	>70	5,081	3,639	28
Copper	4,418	917	79	9,440	3,899	57
Lead	3,921	2,015	49	6,047	6,099	N.D.
Mercury	33	N.D.	>80	129	106	18
Molybdenum	N.D.	N.D.		N.D.		
Nickel	5,279	4,436	16	16,978	36,546	N.D.
Selenium	71	12	83	68	42	38
Silver	N.D.	N.D.		1,536	1,803	70
Zinc	11,114	3,867	65	20,469	9,290	55

[a] N.D. - not detected.

Table 4-2. Metals in Ferric Chloride Solutions

Constituent	Concentration, mg/l[a]
Silver	2
Cadmium	2-3.5
Chromium	10-70
Copper	44-14,200
Nickel	92-6,200
Iron	146,000-188,000
Lead	6-90
Zinc	400-2,150

Source: Orange County Sanitation District laboratory.

[a] Three different liquid sources were analyzed (43 percent $FeCl_3$).

CHAPTER 5

COMPARISONS OF THE SSMP SOURCE SURVEY TO OTHER SURVEYS AND STANDARDS

This chapter presents comparisons of the results of the SSMP Source Survey with three other source surveys conducted by Sacramento County. Comparisons of total loads to Central and City Main with total loads discharged by monitored industries provide identification of most of the heavy metals sources in the Central System but does not identify the major sources in the City Main System. Additionally, results obtained from the SSMP Source survey are compared to data from other municipalities and other pertinent standards.

Summary of Sacramento County Source Surveys

Three toxic material source survey studies have been conducted by the Sacramento County Industrial Waste Section (IWS). These surveys were the "Zinc-Cadmium Study" conducted in April through August 1975; the "Heavy Metals Study" conducted in August 1975; and the "IWS Local Source Control Program" referred to as the "IWS Local Source Survey" in this report, conducted in January through June 1977.

The Zinc-Cadmium Study consisted of analyses of routine influent and effluent samples from ten Sacramento County treatment plants. The influent and effluent samples were collected on four separate days in the months of April through August and analyzed for zinc and cadmium. Results of the influent analyses are presented in Table 5-1.

The Heavy Metals Study consisted of analysis of routine influent samples collected at four treatment plants. Each sample was analyzed for cadmium, chromium, copper, lead, molybdenum, nickel and zinc. The results are presented in Table 5-2.

Table 5-1. Summary of Sacramento County Zinc-Cadmium Study

Facility	Cadmium concentrations (μg/l)					Zinc concentrations (μg/l)				
	3/25	4/8	4/22	8/6	Average	3/25	4/8	4/22	8/6	Average
Northeast										
Influent	0.032	0.024	0.026	0.018	0.025	0.26	0.24	0.21	0.223	0.23
Effluent	0.022	0.016	0.014	0.016	0.017	0.10	0.09	0.10	0.073	0.091
Rancho Cordova										
Influent	0.022	0.020	0.024	0.014	0.02	0.14	0.15	0.16	0.238	0.172
Effluent	0.015	0.016	0.014	0.021	0.165	0.04	0.06	0.06	0.052	0.053
Arden										
Influent	0.023	0.024	0.020	0.018	0.021	0.16	0.15	0.18	0.177	0.167
Effluent	0.018	0.020	0.018	0.017	0.018	0.10	0.08	0.07	0.066	0.079
Highland Estates										
Influent	0.021	0.022	0.022	0.021	0.022	0.18	0.16	0.15	0.193	0.171
Effluent	0.018	0.020	0.014	0.019	0.018	0.08	0.07	0.05	0.069	0.068
CSD #6										
Influent	0.020	0.018	0.016	0.022	0.019	0.21	0.19	0.21	0.126	0.184
Effluent	0.010	0.011	0.012	0.040	0.018	0.08	0.10	0.09	0.119	0.097
Natomas										
Influent	0.026	0.022	0.031	0.025	0.026	0.16	0.18	0.17	0.213	0.181
Effluent	0.021	0.020	0.020	0.021	0.021	0.06	0.08	0.06	0.081	0.070
Central										
Influent	0.023	0.026	0.038	0.023	0.028	0.36	0.32	0.28	0.290	0.313
Effluent	0.016	0.020	0.026	0.018	0.020	0.20	0.16	0.12	0.144	0.156
Arden Gold										
Influent	N.S.[a]	0.026	0.022	0.021	0.023	N.S.	0.17	0.23	0.246	0.215
Effluent	N.S.	0.021	0.021	0.020	0.021	N.S.	0.12	0.16	0.129	0.136
Sabre City										
Influent	0.022	0.031	0.024	0.046	0.031	0.18	0.21	0.18	0.463	0.258
Effluent	0.020	0.026	0.023	0.042	0.028	0.10	0.11	0.11	0.097	0.10
Rio Linda										
Influent	N.S.	N.S.	N.S.	0.037	0.037	N.S.	N.S.	N.S.	0.603	0.603
Effluent	N.S.	N.S.	N.S.	0.042	0.042	N.S.	N.S.	N.S.	0.074	0.074

Source: Study conducted in 1975. Samples collected and analyzed by District personnel.

[a] N.S. - not sampled.

Table 5-2. Summary and Comparison of Sacramento County and SSMP Source Surveys

Facility	Heavy metal concentrations, µg/l											
	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc
Northeast												
1975 Zinc-Cadmium study[a,b]			25									230
1975 Heavy Metals study[a]			18	11	56	85		<10	49			223
1977 I.W.S. Source Survey[a]	3		2	14	80	42	2.4				8	190
Rancho Cordova												
1975 Zinc-Cadmium study[a,b]			70									172
1975 Heavy Metals study[a]			14	25	57	80		<10	39			238
1977 I.W.S. Source Survey[a]	6.7		1,200	930	540	340	2.8				170	
Arden												
1975 Zinc-Cadmium study[a,b]			21									167
1975 Heavy Metals study[a]			18	16	61	70		<10	59			177
1977 I.W.S. Source Survey[a]	2		5	20	80	100	0.7				15	290
Highland Estates												
1975 Zinc-Cadmium study[a,b]			22									171
1975 Heavy Metals study[a]												
1977 I.W.S. Source Survey[a]	2		54	55	53	63	3				37	180
Rio Linda												
1975 Zinc-Cadmium study[a,b]			37									603
1975 Heavy Metals survey[a]												
1977 I.W.S. Source Survey[a]	3		22	47	34	44	1				24	99
CSD #6												
1975 Zinc-Cadmium study[a,b]			19									184
1975 Heavy Metals study[a]												
1977 I.W.S. Source Survey[a]	1		2	10	140	36	0.4				3	260
Natomas												
1975 Zinc-Cadmium study[a,b]			26									181
1975 Heavy Metals Survey[a]												
1977 I.W.S. Source Survey[a]	6		10	16	97	120	1.1				1	120
Central												
1975 Zinc-Cadmium study[a,b]			28									313
1975 Heavy Metals study[a]			23	54	99	147		<10	57			290
1977 I.W.S. Source Survey[a]	4		7	82	110	72	2.4				13	390
SSMP Source Survey[c]												
High	7.6	<10	<10	50	120	100	3	<0.1	160	2.8	0.1	340
Low	1.2	<10	<10	<10	50	50	1	<0.1	50	<0.2	<0.1	14
City Main												
1975 Zinc-Cadmium study[a,b]												
1975 Heavy Metals study[a]												
1977 I.W.S. Source Survey[a]	1.5		50	47	81	34	1.2				27	360
SSMP Source Survey[c]												
High	7.2	<10	<10	40	110	50	1.3	<0.1	150	0.5	0.1	210
Low	1.4	<10	<10	30	40	20	0.4	<0.1	30	<0.2	<0.1	90

[a] Influent samples collected and analyzed by District staff. Samples for metal analysis were taken from routine plant influent samples.

[b] Average value from Zinc-Cadmium study.

[c] Influent samples taken from routine plant influent samples and analyzed by S.A.C.; highest and lowest values from five weekly composites analyzed.

The IWS Local Source Survey was conducted in January through June of 1977. This survey consisted of special analysis of routine influent samples from ten treatment plants. These samples were analyzed for an array of heavy metals, ammonia, cyanide, phenols, TICH[1] and radioactivity. The metal analyses from this survey and comparable data from the SSMP Source Survey are summarized and compared in Table 5-2 along with the results of the Zinc-Cadmium Study and Heavy Metal Study. The complete results of the IWS Local Source Survey are included in Appendix C.

It should be observed that the samples collected in the Heavy Metals Study and the IWS Local Source Survey were one-day composites. They are subject to more variations in metal concentrations than the one-week composite influent samples collected at Central and City Main in the SSMP Source Survey. Compositing a sample over a weeks period tends to attenuate both peak and dilute concentrations.

Comparison of Sacramento Data With Los Angeles Data and Drinking Water Standards

Comparisons of selected heavy metals and chlorinated hydrocarbons are presented in Table 5-3. The high and low values from the SSMP Source Survey are presented for Central and City Main influent and compared with the reported Los Angeles County domestic levels and the EPA Proposed Primary Drinking Water Standards.

This table brings perspective to the Sacramento data and indicates the relatively low concentrations of toxic materials detected in the Central and City Main treatment plant influents.

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[1] In the IWS Source Survey, TICH were reported as a total and not broken out into specific chlorinated hydrocarbons; therefore, it was not possible to compare the results to the SSMP Source Survey results.

Table 5-3. Comparison of Sacramento Data with Los Angeles Data and Drinking Water Standards

Constituent	Central influent		City Main influent		L.A.C.S.D.	E.P.A.
	High	Low	High	Low	Domestic wastewater[a]	Drinking water standards[b]
Metals, mg/l						
Arsenic	.0076	.0012	0.0072	0.0014	0.014	0.05
Beryllium	<0.01	<0.01	<0.01	<0.01	-	-
Cadmium	<0.01	<0.01	<0.01	<0.01	0.005	0.01
Chromium	0.05	<0.01	0.04	0.03	0.02	0.05
Copper	0.12	0.05	0.11	0.04	0.119	-
Lead	0.10	0.05	0.05	0.02	0.051	0.05
Mercury	0.001	0.0003	0.0013	0.0004	0.0005	0.002
Molybdenum	<0.1	<0.1	<0.1	<0.1	-	-
Nickel	0.16	0.05	0.15	0.03	0.031	-
Selenium	0.0028	<0.0002	0.0006	<0.0002	-	0.01
Silver	0.01	<0.01	0.01	<0.01	-	0.05
Zinc	0.34	0.14	0.21	0.09	0.490	-
TICH, ug/l						
PCB 1254	0.38	<0.02	<0.2	<0.02	-	-
Lindane	<0.05	0.1	<0.05	0.05	-	4.0
Methoxychlor	<0.1	<0.1	0.04	<0.1	-	100
Chlordane	2.4	0.5	4.3	1.6	-	3.0

[a] Los Angeles County Sanitation Districts analyses of sewage from domestic service area.

[b] From "EPA Proposed Primary Drinking Water Regulations," March 14, 1975, included in "E.P.A. Municipal Sludge Management Environmental Factors," Federal Register, Volume 41, No. 108, June 3, 1976. EPA Interim Primary Drinking Water Standards effective June 24, 1977 do not include chlordane limit.

For the Central treatment plant influent only lead exceeds the Proposed Primary Drinking Water limit. All other toxic substance levels, including pesticides, detected in the Central and City Main treatment plant influents, were less than the Proposed Primary Drinking Water Standards, except for chlordane done which was slightly higher than the proposed standard for one week. As noted, chlordane was deleted from the adopted standrd.

The Sanitation Districts of Los Angeles County domestic wastewater concentrations are the result of sampling sewage from a residential neighborhood. These concentrations are used by LACSD as the baseline for determining the industries in the Los Angeles area that are discharging wastes in excessive concentrations.

Comparison of Industrial Discharges to Central and City Main Heavy Metal Loads

The average daily metal loads from monitored industries were compared to the total influent load at the appropriate treatment plant to provide a basis for judgment regarding the relative importance of the currently monitored industries as heavy metal sources.

Quantities of heavy metals discharged to the Central and City Main collection systems from major water-producing industries were calculated from flows and concentrations reported in the IWS Local Source Survey. Concentration data were based on one 24-hr composite effluent sample and the flow was the average daily flow. The total heavy metals load discharged by each industry is shown in Table 5-4 and Table 5-5 for the Central and City Main service areas, respectively. In Table 5-6 the total grams per day for each heavy metal from Tables 5-4 and 5-5 are compared to the total grams per day measured at Central and City Main. Comparing the high, average and low range of Central with the total industrial effluent grams per day value, plus the estimated domestic contribution, indicates that most of the heavy metals entering Central can be

Table 5-4. Monitored Industries Tributary to Central

Industry	Total flow,[a] 1,000 gal/yr	Heavy metal loads							
		Arsenic		Cadmium		Chromium		Copper	
		µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]
Campbell Soup	1,951,125	3	61	34	688	28	567	37	749
Pepsi Cola	3,721	6.5	0.3	360	13.9	560	21.6	440	17.0
Procter & Gamble	138,812	<1	0	18	25.9	26	37.4	160	230
Sacramento Army Depot	51,789	2	1.1	86	46.2	150	80.6	81	43.5
Safeway District Center	73,158	3	2.3	12	9.1	25	19.0	93	70.6
Union Carbide	2,489	4	0.1	46	1.2	22	0.6	19	0.5
Total			64.8		784.3		726.2		1,110.6

[a] 1976-77 water meter readings.

[b] Measured concentration from 24-hour composite sample.

[c] Estimates based on one 24-hour composite from each industry and 1976-77 total water flow divided by 365 days per year.

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Table 5-4. Monitored Industries Tributary to Central (continued)

Industry	Heavy metal loads							
	Lead		Mercury		Silver		Zinc	
	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]
Campbell Soup	16	324	2	40	5	101	87	1,760
Pepsi Cola	470	18.1	4.6	0.2	150	5.8	1,400	54.0
Procter & Gamble	94	1.4	0.2	0.1	24	34.5	120	172.7
Sacramento Army Depot	39	20.9	0.6	0.3	27	14.5	250	134.3
Safeway District Center	150	113.8	1.4	1.1	7	5.3	610	462.8
Union Carbide	18	0.5	2	0.1	11	0.8	190	3.4
Total		478.70		42.0		161.90		2,587.20

[a] 1976-77 water meter readings.

[b] Measured concentration from 24-hour composite sample.

[c] Estimates based on one 24-hour composite from each industry and 1976-77 total water flow divided by 365 days per year.

Table 5-5. Monitored Industries Tributary to City Main

Industry	Total flow[a]	Heavy metal loads							
	1,000 gal/yr	Arsenic		Cadmium		Chromium		Copper	
		µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]
Almond Growers	58,595	4	2	38	23	36	22	45	27
American Poultry	3,387	2	0.07	6	0.21	11	0.39	27	0.95
Chef's Best	17,925	1	0.19	9	1.7	12	2.2	10	1.9
Claus & Kraus	8,741	0.4	0.04	30	2.72	9	0.82	24	2.18
Coca Cola	18,994	2.1	0.4	59	11.6	51	10.0	79	15.6
Community Linen	30,180	0.8	0.3	50	15.6	65	20.3	78	24.4
Crystal Creamery	44,295	3	1.6	10	4.6	10	2.1	63	28.9
Foremost Dairy	43,925	2	0.9	24	10.9	16	7.3	28	12.8
Libby-McNeil-Libby	273,644	7	17	18	44	26	64	52	128
Made-rite (Broadway)	5,054	<1	0	10	5.2	7	3.7	51	26.7
Meridith Fish	33,884	3	1.1	11	3.9	15	5.3	130	45.7
National Linen	20,732	1.1	0.2	57	12.3	36	7.7	102	21.9
Red Star Ind. Service	25,718	6	1.6	92	24.5	210	56.0	490	130.7
Royal Crown	6,571	3	0.2	7	0.5	41	2.8	57	3.9
Sacramento State College	52,000	3	1.6	30	16.2	25	13.5	66	35.6
Setzer Box	26,274	<1	0	3	0.1	8	2.2	35	9.5
Seven-Up Bottling Co.	13,731	1	0.1	14	2.0	17	2.4	30	4.3
Shasta Linen	6,283	2	0.1	15	1.0	22	1.4	25	1.6
Southern Pacific RR	100,187	2	2.1	22	22.9	38	39.5	36	37.4
Vita Freeze	12,740	4	0.5	14	1.9	35	4.6	47	6.2
Western Pacific RR	10,568	3	0.3	5	0.5	16	1.8	68	7.5
City Main Total			30.30		205.33		270.01		572.73

[a] 1976-77 water meter readings.

[b] Measured concentration from 24-hour composite effluent sample.

[c] Estimates based on one 24-hour composite from each industry and 1976-77 total water flow divided by 365 days per year.

Table 5-5. Monitored Industries Tributary to City Main
(continued)

Industry	Heavy metal loads[a]							
	Lead		Mercury		Silver		Zinc	
	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]	µg/l[b]	gms/day[c]
Almond Growers	17	10	1	1	5	3	80	49
American Poultry	28	0.98	1	0.04	4	0.14	80	2.81
Chef's Best	16	3.0	1	0.2	13	2.4	38	7.1
Claus & Kraus	18	1.63	0.5	0.05	8	0.73	130	11.78
Coca Cola	45	8.9	0.7	0.1	7	1.4	340	67.0
Community Linen	35	11.0	1	0.3	37	11.6	280	87.6
Crystal Creamery	55	25.3	1.2	0.6	1	0.5	570	261.8
Foremost Dairy	12	5.5	1	0.5	16	7.3	88	40.1
Libby-McNeil-Libby	22	54	3	7	5	12	170	419
Made-rite (Broadway)	59	30.9	0.2	0.1	4	2.1	390	204.4
Meridith Fish	65	22.8	0.7	0.2	3	1.1	890	312.7
National Linen	73	15.7	1.7	0.4	11	2.4	440	94.6
Red Star Ind. Service	1,360	362.7	1.3	0.3	8	2.1	1,860	496.0
Royal Crown	12	0.8	2	0.1	1	0.1	61	4.2
Sacramento State College	28	15.1	1.0	0.5	24	12.9	130	70.1
Setzer Box	40	10.9	0.2	0.1	3	0.8	80	21.8
Seven-Up Bottline Co.	84	12.0	1	0.1	27	3.8	63	9.0
Shasta Linen	52	3.4	2	0.1	5	0.3	120	7.8
Southern Pacific RR	63	65.4	3	3.1	3	3.1	363	377.1
Vita Freeze	65	8.6	3	0.4	10	1.3	382	50.3
Western Pacific RR	96	10.5	0.8	0.1	4	0.4	140	15.3
City Main Total		679.11		15.29		69.47		2,609.69

[a] 1976-77 water meter readings.

[b] Measured concentration from 24-hour composite effluent sample.

[c] Estimated based on one 24-hour composite from each industry and 1976-77 total water flow divided by 365 days per year.

Table 5-6. Comparison of Industrial Effluent Heavy Metals to Central and City Main Influent Heavy Metals

	Loads (gms/day)							
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc
Central								
Influent load								
High	403	2,029	2,650	6,359	5,337	53	530	18,016
Average	193	707	1,753	4,418	3,921	33	397	11,114
Low	64	130	1,067	2,668	3,179	16	304	8,005
Industrial effluent load	65	754	726	1,111	479	42	162	2,587
Estimated domestic load	182	260	770	3,445	1,030	84	226	12,868
Percent of average influent load accounted for[a]	128	143	85	103	38	382	98	139
City Main								
Influent load								
High	1,150	336	6,390	17,570	7,986	208	1,597	33,543
Average	567	283	5,081	9,440	6,047	129	1,536	20,469
Low	221	219	4,304	5,390	2,695	61	1,434[b]	14,205
Industrial effluent load	30	205	270	573	679	15	70	2,610
Estimated domestic load	111	159	470	2,103	629	52	138	7,856
Percent of average influent load accounted for[a]	25	130	15	28	22	52	14	51

[a] Calculation: $\frac{\text{Industrial Effluent Load + Estimated Domestic Load}}{\text{Average Plant Influent Load}}$ x 100 = percent of average influent load accounted for.

accounted for by the currently monitored industries. It should be noted, though, that the principal source of heavy metals in this comparison is from Campbell Soup Company as indicated in Table 5-4. Additional analysis of Campbell Soup should be undertaken to verify if this is the case.

For City Main, the measured industries, plus estimated domestic contributions, account for only a small portion of the heavy metals measured at the City Main plant. It is apparent that there are significant sources of heavy metals within the City Main collection system that are not being monitored.

Heavy metal concentrations in plating plant effluents were recently sampled and analyzed by the Industrial Waste Section. The results of these analyses from the eight plating shops tributary to City Main are presented in Table 5-7. Only one of the shops is supplied through a metered water service. Therefore, the wastewater flows associated with these concentrations are not known. Additional sampling and determination of flows should be initiated to determine the total mass of heavy metals being discharged to City Main. This should determine if the plating shops are responsible for discharging the relatively high quantities of chromium, copper, lead and silver found in the City Main influent.

Table 5-7. Heavy Metal Analysis of Plating Shop Effluents Tributary to City Main

Plating shops	Concentrations (mg/l)						
	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
16 Street Plating							
Grab[a]	0.03	1.6	1.63	0.12	0.44	0.49	0.002
24-hour composite alley[b]	0.048	0.82	0.80	0.28	1.34	0.14	0.012
Sacramento Plating							
Grab[a]	0.18	0.55	42.5	0.37	1.96	4.12	0.008
24-hour composite alley[b]	0.017	3.11	1.6	0.023	0.062	0.160	0.004
Chrome Craft							
Grab[a]	0.06	300	0.751	1.12	1.46	1.44	0.004
24-hour composite alley[b]	0.011	4.1	0.077	0.211	0.15	0.14	-
Bottle 11[c]	0.057	67.2	0.69	0.270	0.54	1.54	-
Bottle 12[c]	0.008	3.1	0.052	0.130	0.12	0.13	-
Bottle 19[c]	0.013	15	0.080	0.180	0.26	0.096	-
24-hour composite alley[b]	0.03	2.7	0.19	0.50	0.13	0.40	0.005
Alley grab	0.086	7.3	0.22	0.71	0.31	0.87	0.010
A-1 Plating							
Grab[a]	0.10	3.78	0.673	0.15	0.33	1.16	0.006
24-hour composite alley[b]	0.082	1.5	0.28	0.26	1.07	0.32	0.002
Grab from manhole	0.13	12.6	0.51	0.51	3.70	0.88	0.007
Alta Plating							
Grab[a]	0.95	0.79	1.36	0.12	0.79	1.72	0.003
Composite from alley[b]	0.24	2.1	0.79	0.21	1.13	1.95	0.009
Hansen's Plating							
Grab[a]	0.04	0.07	0.31	0.07	0.046	0.50	0.002
Aladdin Plating							
Grab[a]	0.07	0.17	14.1	0.27	1.71	2.26	0.018
Gerling Motors							
Grab[a]	1.1	72	0.22	0.49	3.8	2.1	0.035
24-hour composite alley[b]	0.086	5.8	0.11	0.081	0.12	0.70	0.005

[a] Sample collected in sump inside shop.

[b] Sample collected from first down stream manhole from plating shop.

[c] Bottle from discrete automatic sample, represents a single grab sample.

CHAPTER 6

SUMMARY AND RECOMMENDATIONS

The Sewage Sludge Management Program (SSMP) Source Survey was conducted to determine the amounts of heavy metals and chlorinated hydrocarbons being discharged to Sacramento Regional County Sanitation District (SRCSD) treatment plants. Raw sludge samples were collected daily for five weeks (April 17-May 21, 1977) at ten SRCSD treatment plants. At two of these plants, Central and City Main, influent and effluent samples were also collected. Composites were made of each weekly series of samples and these were analyzed for 12 heavy metals and an array of chlorinated hydrocarbons. An estimated domestic heavy metal load was developed for each plant and was compared to the measured heavy metal load. This study revealed those treatment plants that are receiving excessive levels of heavy metals.

A comparison of the heavy metal loads in the raw sludges of the ten sampled plants revealed that Northeast, Highland Estates, CSD #6 and Meadowview receive only domestic levels of heavy metals. Rancho Cordova, Arden, Rio Linda, and Natomas plants, although predominantly residential, do serve some light industries and commercial establishments. Total heavy metal loads to these plants are generally domestic in character but there are periodic discharges of some heavy metals.

A range of domestic per capita loads was developed for each heavy metal based on data from Northeast, Highland Estates, CSD #6, and Meadowview treatment plants. Metal concentrations in the raw sludge in the highest week and lowest week from any of the four plants was selected to define a range of metal concentrations characterized by domestic wastewater sludges. These concentrations were converted to a per capita load for each heavy metal. The domestic unit loads were used to develop an estimated total domestic load to determine which plants receive excessive discharges of heavy metals.

The ratios of average plant heavy metal loads, as measured in the raw sludges, to the plant's estimated domestic load are shown in Table 6-1. These ratios are based on the average plant loads as measured in the raw sludges for the five weeks sampled for the named plants. The domestic value is based on the high value of the domestic range as given in Chapter 3.

The ratios presented in Table 6-1 are summarized in Table 6-2. The quantities of heavy metals in excess of estimated domestic loads are categorized as follows:

1. Not significantly in excess of domestic levels

2. Moderately in excess of domestic levels

3. Greatly in excess of domestic levels

The table also indicates which of the heavy metals have an identified source. The identified sources are among those industries that are currently monitored by the Sacramento County Industrial Waste Section. For the Central plant, the currently monitored industries appear to be the sources of the measured heavy metal load. For the City Main plant, however, the currently monitored industries do not account for the measured heavy metal loads.

Chlorinated hydrocarbons were also measured in the raw sludges, influents, and effluents on the same schedule as heavy metals. It was determined that there is no consistent detectable load of chlorinated hydrocarbons in domestic wastewaters. Concentrations of chlorinated hydrocarbons in Central and City Main were compared

Table 6-1. Ratios of Plant Loads to Estimated Domestic Loads

Heavy metal	Ratios[a]					
	Central	City Main	Rancho Cordova	Arden	Rio Linda	Natomas
Arsenic	1.8	4.0	3.3	1.3	4.0	10.0
Beryllium[b]	0	0	0	0	0	0
Cadmium	2.9	1.8	<1	<1	1.8	<1
Chromium	3.3	10.0	<1	2.0	6.7	1.7
Copper	1.3	4.0	1.5	1.7	5.0	1.1
Lead	1.3	4.0	1.3	<1	2.5	<1
Mercury	<1	2.9	<1	1.7	3.3	<1
Molybdenum[b]	0	0	0	0	0	0
Nickel	1.3	6.7	1.7	<1	2.5	1.1
Selenium	<1	1.4	1.4	<1	1.7	<1
Silver	1.8	10.0	1.3	5.0	2.5	<1
Zinc	1.1	2.9	<1	1.3	5.0	1.2

[a] Ratio of average plant load for five weeks sampled to estimated domestic load based on raw sludge data.

[b] Metals not detected in either raw sludges or influents.

Table 6-2. Summary of Ratios of Plant Loads to Estimated Domestic Loads

Heavy metal	Classifications of heavy metal loads					
	Central	City Main	Rancho Cordova	Arden	Rio Linda	Natomas
Arsenic	1	3B	2A	1	3B	3B
Beryllium	1	1	1	1	1	1
Cadmium	2A	1	1	1	1	1
Chromium	2A	3B	1	1	3B	1
Copper	1	3B	1	1	3B	1
Lead	1	3B	1	1	2B	1
Mercury	1	2A	1	1	2B	1
Molybdenum	1	1	1	1	1	1
Nickel	1	3B	1	1	2B	1
Selenium	1	1	1	1	1	1
Silver	1	3B	1	3B	2B	1
Zinc	1	2A	1	1	3B	1

Definitions of Classifications	
Class. 1	Heavy metal load not significantly in excess of domestic levels (ratio less than or equal to 2).[a]
Class. 2	Heavy metal load moderately in excess of domestic levels (ratio between 2 and 3.5).[a]
Class. 2A	Load accounted for by currently monitored industries.
Class. 2B	Load not accounted for by currently monitored industries.
Class. 3	Heavy metal load greatly in excess of domestic levels (ratio greater than 3.5).[a]
Class. 3A	Same as 2-A (above).
Class. 3B	Same as 2-B (above).

[a] Ratio of average plant load (for five weeks sampled) to estimated domestic load based on raw sludge data (Table -1).

to the Proposed Primary Drinking Water Standards, and in all but one week the measured concentrations in Central and City Main influents were significantly less. Similarly, the concentrations of chlorinated hydrocarbons in the raw sludges were low enough to qualify the sludge as a Class I sludge as described by the California State Department of Health.

The following conclusions are drawn from Phase I of the SSMP Source Survey:

1. Central and City Main heavy metal loads are in excess of domestic loads.

2. Central heavy metal loads can generally be accounted for by measured loads in effluents of currently monitored industries.

3. City Main heavy metal loads cannot generally be accounted for by measured loads in effluents of currently monitored industries.

4. Periodically, excessive loads of one or two heavy metals were detected in raw sludges of Rancho Cordova, Arden, Rio Linda and Natomas.

Recommendations

Recommendations for continuation of the SSMP Source Survey are limited to those tasks which will help identify the principal sources of heavy metal and chlorinated hydrocarbons discharges to the SRCSD collection system, and will more accurately determine the magnitude of these discharges. Only after the magnitude and sources of the discharges have been documented can it be determined whether it is appropriate and cost-effective to undertake source control programs for heavy metals or chlorinated hydrocarbons. Any source control measures must, of course, be considered in relation to the impact they have on industry, Regional Plant effluent, and final sludge disposal.

The following tasks should be completed in Phase II of the SSMP Source Survey; most or all of this work could be completed by the Sacramento County Industrial Waste Section:

1. The currently unidentified sources of arsenic, chromium, copper, lead, nickel, and silver discharged to the City Main system should be identified. Plating industries are a potential source of these heavy metals. Additional monitoring, including measurement of the quantity of wastewater from these industries, is needed.

2. Sampling programs should be designed to verify that the suspected sources of heavy metal discharges to Central are accurate. It appears that Campbell Soup Company may be the principal source of excessive levels of cadmium and chromium measured at Central. Confirmation of this will require coordinated sampling of Campbell Soup effluent and Central influent.

3. Sources of arsenic at Rancho Cordova and Natomas should be investigated as should sources of heavy metals at Rio Linda. This, however, because the masses of heavy metals discharged to Rancho Cordova, Arden, Rio Linda, and Natomas do not represent major discharges when considered in relation to the overall regional system loads.

4. Analysis of some daily samples of raw sludge, influents and effluents in freezer storage should be performed. These

analyses will indicate whether the discharge was relatively constant or variable through the week. Only two sets of samples merit reanalysis at this time:

a. Daily effluent samples at City Main for all five weeks had higher measured concentrations of lead and nickel than the influent, and, therefore, the influent and effluent samples should be reanalyzed for lead and nickel.

b. Raw sludge and influent daily samples at Central for weeks 3 and 4 should be reanalyzed for cadmium and chromium to see if they reflect peak day discharges or high levels for the entire week.

It is not likely that analysis of any additional samples would influence the course of action outlined in these recommendations.

APPENDIX A

SUMMARY OF ANALYTICAL RESULTS BY CONSTITUENT

APPENDIX A

ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

ARSENIC

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	5.6	6.4	11.0	6.6	9.2	2.3	7.76
Rancho Cordova	55.0	<2.8	<1.0	1.9	3.6	24	12.1
Arden	4.1	8.4	8.6	5.2	13	3.5	7.9
Highland Estates	12.0	3.7	4.0	4.5	6.5	3.5	6.1
Rio Linda	5.2	13	13	14	26	7.5	14.2
C.S.D. #6	3.3	2.3	6.3	6.4	5.1	1.8	4.7
Natomas	6.9	8.2	237	8.2	8.6	102.4	53.8
Central	11.0	29	8.9	19	13	8.1	16.2
Meadowview	3.7	6.4	4.0	9.7	5.7	2.4	5.9
City Main	7.0	14	21	18	21	5.9	16.2

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.0076	0.0012	0.0026	0.0024	0.0040	0.0025	0.0036
	Effluent	0.0056	0.0014	0.0015	0.0004	0.0007	0.0021	0.0019
City Main	Influent	0.0072	0.0014	0.0024	0.0051	0.0027	0.0024	0.0038
	Effluent	0.0083	0.0018	0.0017	0.0014	0.0008	0.0033	0.0029

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

APPENDIX A

ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

BERYLLIUM

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	<3.3	<1.3	<0.7	<1.1	<1.0		N.D.
Rancho Cordova	<1.9	<4.5	<1.3	<1.2	<2.2		N.D.
Arden	<4.4	<1.5	<1.4	<1.1	<3.3		N.D.
Highland Estates	<3.9	<1.3	<1.0	<0.9	<1.0		N.D.
Rio Linda	<2.5	<1.5	<1.7	<1.3	<1.5		N.D.
C.S.D. #6	<3.6	<1.3	<1.0	<0.8	<1.0		N.D.
Natomas	<2.3	<0.9	<1.1	<0.9	<1.3		N.D.
Central	<2.2	<1.3	<1.1	<0.8	<1.0		N.D.
Meadowview	<2.0	<1.0	<5.8	<0.9	<1.1		N.D.
City Main	<2.1	<1.6	<1.7	<1.1	<1.1		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	<0.01	<0.01	<0.01	<0.10	<0.01		N.D.
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
City Main	Influent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

CADMIUM

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	3.7	2.6	1.4	2.2	4.2	1.1	2.8
Rancho Cordova	4.3	4.5	2.6	1.2	2.2	1.4	3.0
Arden	7.7	7.4	2.7	2.3	6.7	2.6	5.4
Highland Estates	5.0	3.8	2.9	2.8	5.9	1.3	4.1
Rio Linda	11.0	9.1	8.3	6.2	14	2.9	9.7
C.S.D. #6	9.1	1.3	1.0	2.5	4.2	3.3	3.6
Natomas	3.9	3.6	2.2	2.8	5.1	1.1	3.5
Central	8.3	9.0	72	43.0	12	28.1	28.9
Meadowview	4.4	4.0	2.3	2.6	2.2	1.0	3.1
City Main	13.0	11.0	10	7.6	11	2.0	10.5

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
City Main	Influent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

APPENDIX A

ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

CHROMIUM

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	24	24	26	26	24	1.1	24.8
Rancho Cordova	8.7	18	12	4.8	6.5	5.2	10.0
Arden	54	65	43	41	70	12.9	54.6
Highland Estates	35	60	46	46	49	8.9	47.2
Rio Linda	96	95	100	66	100	14.4	91.4
C.S.D. #6	20	27	24	27	18	4.1	23.2
Natomas	29	34	66	20	28	17.8	35.4
Central	92	170	110	92	110	32.1	114.8
Meadowview	20	20	35	18	19	7.1	22.4
City Main	190	300	280	160	220	59.2	230

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.05	0.02	<0.01	0.03	0.02	0.02	0.02
	Effluent	<0.01	0.02	<0.01	<0.01	<0.01	0.01	0.004
City Main	Influent	0.04	0.03	0.03	0.03	0.04	0.01	0.03
	Effluent	0.03	0.04	<0.01	0.02	0.02	0.01	0.02

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

COPPER

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	100	99	100	98	100	1	99
Rancho Cordova	110	180	90	45	96	49	104
Arden	190	220	160	170	270	44	202
Highland Estates	180	180	150	150	180	16	168
Rio Linda	380	410	400	250	350	65	358
C.S.D. #6	130	130	120	120	94	15	119
Natomas	120	110	130	67	92	25	104
Central	190	220	200	180	190	15	196
Meadowview	120	120	150	110	130	15	126
City Main	320	360	320	280	350	31	326

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.12	0.05	0.08	0.08	0.05	0.03	0.08
	Effluent	0.02	0.02	0.02	0.01	0.01	0.01	0.02
City Main	Influent	0.11	0.05	0.06	0.05	0.04	0.03	0.06
	Effluent	0.03	0.03	0.02	0.02	0.03	0.01	0.03

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

LEAD

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	31	22	14	13	28	8	22
Rancho Cordova	39	59	13	9.5	13	22	27
Arden	23	24	19	6.8	20	7	19
Highland Estates	40	25	24	11	24	10	25
Rio Linda	64	48	67	25	58	17	52
C.S.D. #6	36	22	17	15	18	8	22
Natomas	33	26	29	13	18	8	24
Central	120	97	30	63	40	38	70
Meadowview	38	25	22	16	18	9	24
City Main	140	110	52	49	110	40	92

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.08	0.10	0.06	0.05	0.05	0.02	0.07
	Effluent	0.04	0.07	0.04	0.02	<0.01	0.02	0.04
City Main	Influent	0.05	0.05	0.02	0.06	0.02	0.02	0.04
	Effluent	0.05	0.05	0.04	0.05	<0.01	0.02	0.04

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

APPENDIX A

ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

MERCURY

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	1.5	1.6	2.4	2.6	2.6	0.5	2.1
Rancho Cordova	0.61	1.0	0.89	0.35	1.0	0.3	0.8
Arden	3.5	6.8	3.9	3.1	6.8	1.8	4.8
Highland Estates	2.1	3.5	4.7	2.0	2.2	1.2	2.9
Rio Linda	5.0	6.5	6.2	3.6	6.6	1.3	5.6
C.S.D. #6	2.4	2.9	1.7	2.3	1.8	0.5	2.2
Natomas	0.96	1.7	2.0	0.66	0.9	1.2	1.2
Central	4.0	4.3	4.2	2.8	3.3	0.5	3.7
Meadowview	2.4	3.8	3.3	2.6	3.2	0.5	3.1
City Main	5.4	5.3	5.3	4.0	5.6	0.6	5.1

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.001	0.0003	0.0005	0.0007	0.0003	0.0003	0.0006
	Effluent	0.0004	< 0.0001	0.0001	< 0.0001	< 0.0001	0.0002	0.0001
City Main	Influent	0.0013	0.0007	0.0004	0.0010	0.0009	0.0003	0.0009
	Effluent	0.001	0.0025	0.0004	0.0002	0.0002	0.001	0.0009

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

MOLYBDENUM

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	<19	<13	< 7.1	<11	<10		N.D.
Rancho Cordova	<44	<45	<13	<12	<23		N.D.
Arden	<39	<15	<14	<11	<33		N.D.
Highland Estates	<25	<13	< 9.6	< 9.2	< 9.8		N.D.
Rio Linda	<70	<15	<17	<13	<15		N.D.
C.S.D. #6	<23	<13	< 9.8	< 8.3	<10		N.D.
Natomas	<20	< 8.9	<11	< 9.3	<13		N.D.
Central	<21	<13	<11	< 8.3	<10		N.D.
Meadowview	<22	<10	< 5.8	< 8.0	<11		N.D.
City Main	<21	<16	<17	<11	<11		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
City Main	Influent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

NICKEL

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	7.4	13	14	15	10	3.4	12.1
Rancho Cordova	18	77	15	12	4.3	29.4	25.3
Arden	23	34	19	20	33	7.2	25.8
Highland Estates	15	28	16	19	13	5.9	18.2
Rio Linda	36	48	37	31	39	6.2	38.2
C.S.D. #6	27	18	20	21	14	4.7	20.0
Natomas	20	25	37	17	19	8.0	23.6
Central	42	27	41	68	54	15.4	46.4
Meadowview	20	18	16	24	12	4.5	18.0
City Main	64	83	92	160	120	37.3	103.8

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.05	0.10	0.06	0.16	0.07	0.04	0.09
	Effluent	0.07	0.08	0.08	0.12	0.03	0.03	0.08
City Main	Influent	0.03	0.07	0.15	0.12	0.03	0.05	0.08
	Effluent	0.29	0.26	0.23	0.26	0.17	0.05	0.24

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

APPENDIX A

ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

SELENIUM

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	0.4	0.6	0.26	<0.08	1.5	0.57	0.55
Rancho Cordova	0.3	2.7	0.98	<0.36	2.3	1.20	1.26
Arden	0.7	1.7	0.18	0.73	3.8	1.44	1.42
Highland Estates	1.7	1.7	1.3	<0.07	2.9	1.04	1.52
Rio Linda	0.9	2.6	0.71	<0.07	3.6	1.49	1.56
C.S.D. #6	0.8	0.1	0.89	<0.07	0.7	0.42	0.50
Natomas	0.5	1.0	0.70	0.85	1.1	0.21	0.76
Central	0.6	1.5	1.1	1.05	1.1	0.32	1.07
Meadowview	0.4	1.2	0.20	0.56	0.8	0.39	0.63
City Main	1.2	1.8	1.1	0.43	2.4	0.75	1.39

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.0028	0.0006	0.0006	<0.0002	<0.0002	0.0012	0.0008
	Effluent	<0.0002	0.0001	0.0003	<0.0002	<0.0002	0.0001	0.0001
City Main	Influent	0.0006	0.0001	0.0006	<0.0002	<0.0002	0.0003	0.0003
	Effluent	0.0005	0.0001	0.0004	<0.0002	<0.0002	0.0002	0.0002

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

SILVER

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	9.3	7.9	8.6	9.8	10	0.9	9.1
Rancho Cordova	4.3	9.1	6.4	2.4	6.5	2.5	5.7
Arden	31.0	43.0	30	49	60	12.6	42.6
Highland Estates	2.5	1.2	1.0	2.8	2.0	0.8	1.9
Rio Linda	11.0	12	10	8.8	12	1.4	10.8
C.S.D. #6	2.3	3.8	4.9	2.5	3.1	1.1	3.3
Natomas	2.0	1.8	3.3	1.9	1.3	0.7	2.1
Central	21	21.0	20	15	15	3.1	18.0
Meadowview	2.2	4.0	2.3	3.5	3.2	0.8	3.0
City Main	60	72	58	49	73	10.1	62.4

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.01	<0.01	<0.01	<0.01	<0.01		<0.01
	Effluent	<0.01	<0.01	<0.01	<0.01	<0.01		N.D.
City Main	Influent	0.01	0.01	<0.01	<0.01	<0.01		0.004
	Effluent	<0.01	0.01	0.02	<0.01	<0.01		0.006

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

ZINC

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	410	400	370	430	460	34	414
Rancho Cordova	230	460	220	120	240	125	254
Arden	500	600	430	470	800	148	560
Highland Estates	580	610	530	510	550	40	556
Rio Linda	1300	1300	1400	920	1400	199	1264
C.S.D. #6	410	450	380	360	310	53	382
Natomas	410	460	520	300	380	83	414
Central	620	720	620	490	660	84	622
Meadowview	420	500	370	400	420	48	422
City Main	830	1000	920	640	900	136	858

Analysis of Influent and Effluent

Treatment Facility		Week[1] mg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.34	0.15	0.15	0.22	0.14	0.08	0.20
	Effluent	0.07	0.06	0.08	0.07	0.05	0.01	0.07
City Main	Influent	0.21	0.09	0.11	0.16	0.11	0.05	0.14
	Effluent	0.06	0.06	0.07	0.06	0.06	0.004	0.06

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] mg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

POLYCHLORINATED BIPHENYLS: #1254

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	1.6	<2.5	<1.3	<1.9	<2.9	0.72	0.32
Rancho Cordova	<3.6	<2.8	<7.9	<8.9	<1.9		N.D.
Arden	<4.5	<5.6	<4.2	<2.5	<7.9		N.D.
Highland Estates	<1.9	<2.6	<1.8	<1.7	<2.4		N.D.
Rio Linda	3.7	4.3	<2.5	2.5	<2.3	2.02	2.1
C.S.D. #6	2.0	<3.1	<4.6	<1.7	<2.4	0.89	0.4
Natomas	1.5	<1.9	<3.1	<3.8	<5.0	0.67	0.3
Central	1.6	1.9	2.9	1.3	1.1	0.71	1.76
Meadowview	2.0	<1.8	<0.6	<2.6	2.9	1.38	0.98
City Main	2.9	4.4	4.4	<1.8	3.6	1.82	3.06

Analysis of Influent and Effluent

Treatment Facility		Week[1] µg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	<1.0	0.38	<0.02	0.3	0.2	0.17	0.18
	Effluent	<0.2	<0.2	<0.02	<0.2	<0.2		N.D.
City Main	Influent	<1.0	<0.2	<0.02	<0.2	<0.2		N.D.
	Effluent	<0.4	<0.2	<0.02	<0.2	<0.2		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] µg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

POLYCHLORINATED BIPHENYLS: #1242

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	<1.6	<2.5	<1.3	<1.9	<2.9		N.D.
Rancho Cordova	<8.6	<2.8	<7.9	<8.9	<1.9		N.D.
Arden	<4.5	<5.6	<4.2	<2.5	<7.9		N.D.
Highland Estates	<1.9	<2.6	<1.8	<1.7	<2.7		N.D.
Rio Linda	<3.7	<2.4	<2.5	<1.8	<2.8		N.D.
C.S.D. #6	<2.0	<3.1	<4.6	<1.7	<2.4		N.D.
Natomas	<1.3	<1.9	<3.1	<3.8	<5.0		N.D.
Central	<1.1	<1.9	<2.1	<1.1	<2.9		N.D.
Meadowview	<2.0	<1.8	<0.6	<2.6	<1.1		N.D.
City Main	<2.1	<3.1	<2.2	<1.8	<2.3		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] µg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	<1.0	<0.2	<0.2	<0.2	<0.2		N.D.
	Effluent	<0.2	<0.2	<0.2	<0.2	<0.2		N.D.
City Main	Influent	<1.0	<0.2	<0.2	<0.2	<0.2		N.D.
	Effluent	<0.4	<0.2	<0.2	<0.2	<0.2		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] µg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

PESTICIDES: ALDRIN

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	<1.6	N.D.	N.D.	N.D.	N.D.		N.D.
Rancho Cordova	<8.6	N.D.	N.D.	N.D.	N.D.		N.D.
Arden	4.5	N.D.	N.D.	N.D.	N.D.		N.D.
Highland Estates	<1.9	N.D.	N.D.	N.D.	N.D.		N.D.
Rio Linda	<3.7	N.D.	N.D.	N.D.	N.D.		N.D.
C.S.D. #6	<2.0	N.D.	N.D.	N.D.	N.D.		N.D.
Natomas	<1.3	N.D.	N.D.	N.D.	N.D.		N.D.
Central	<2.0	N.D.	N.D.	N.D.	N.D.		N.D.
Meadowview	<1.1	N.D.	N.D.	N.D.	N.D.		N.D.
City Main	<2.1	N.D.	N.D.	N.D.	N.D.		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] µg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
	Effluent	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
City Main	Influent	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
	Effluent	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] µg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

PESTICIDES: HEXACHLOROBENZENE

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	N.D.	<0.5	<0.3	<0.4	<0.6		N.D.
Rancho Cordova	N.D.	<5.6	<1.6	<1.8	<3.7		N.D.
Arden	N.D.	<1.1	0.8	<0.5	<1.6	0.72	0.48
Highland Estates	N.D.	<0.5	<0.4	<0.3	<0.5		N.D.
Rio Linda	N.D.	<0.5	<0.5	<0.4	<0.6		N.D.
C.S.D. #6	N.D.	<0.6	<0.9	<0.3	<0.5		N.D.
Natomas	N.D.	<0.4	<0.6	<0.8	<1.0		N.D.
Central	N.D.	0.3	0.4	<0.2	<0.2	0.19	0.14
Meadowview	N.D.	<0.4	<0.1	<0.5	<0.6		N.D.
City Main	N.D.	<0.6	<0.4	<0.4	<0.5		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] µg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	0.11	0.09	0.05	<0.05	<0.05	0.05	0.05
	Effluent	<0.05	0.05	<0.05	<0.05	<0.05		N.D.
City Main	Influent	<0.05	<0.05	<0.05	<0.05	<0.05		N.D.
	Effluent	<0.05	<0.05	<0.05	<0.05	<0.05		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] µg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

PESTICIDES: LINDANE

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	N.D.	<0.5	<0.3	<0.4	0.6	0.27	0.12
Rancho Cordova	N.D.	<5.6	<1.6	<1.8	<3.7		N.D.
Arden	N.D.	<1.1	<0.8	1.0	<1.6	0.45	0.2
Highland Estates	N.D.	<0.5	<0.4	<0.3	<0.5		N.D.
Rio Linda	N.D.	<0.5	<0.5	<0.4	<0.6		N.D.
C.S.D. #6	N.D.	<0.6	<0.9	<0.4	<0.5		N.D.
Natomas	N.D.	<0.4	<0.6	<0.8	<1.0		N.D.
Central	N.D.	<0.3	<0.4	<0.2	<0.2		N.D.
Meadowview	N.D.	<0.4	<0.1	<0.5	<0.6		N.D.
City Main	N.D.	<0.6	<0.4	<0.4	<0.5		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] µg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	N.D.	0.1	0.07	0.06	0.08	0.42	0.24
	Effluent	N.D.	<0.05	<0.05	<0.05	<0.05		N.D.
City Main	Influent	N.D.	<0.05	<0.05	0.05	0.05	0.03	0.02
	Effluent	N.D.	<0.05	<0.05	<0.05	<0.05		N.D.

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] µg/l on a well mixed sample.
[4] Standard Deviation.

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ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

PESTICIDES: METHOXYCHLOR

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Rancho Cordova	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Arden	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Highland Estates	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Rio Linda	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
C.S.D. #6	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Natomas	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Central	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
Meadowview	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.
City Main	N.D.	N.D.	N.D.	N.D.	N.D.		N.D.

Analysis of Influent and Effluent

Treatment Facility		Week[1] µg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	<0.1	N.D.	N.D.	N.D.	N.D.		N.D.
	Effluent	<0.1	N.D.	N.D.	N.D.	N.D.		N.D.
City Main	Influent	0.4	N.D.	N.D.	N.D.	N.D.	0.18	0.08
	Effluent	0.1	N.D.	N.D.	N.D.	N.D.	0.04	0.02

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[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] µg/l on a well mixed sample.
[4] Standard Deviation.

APPENDIX A

ANALYTICAL RESULTS FOR RAW SLUDGES, INFLUENTS AND EFFLUENTS

PESTICIDES: TECHNICAL CHLORDANE

Analysis of Sludge

Treatment Facility	Week[1] mg/kg[2]					Summary	
	1	2	3	4	5	Std.[4] Dev.	Average
Northeast	2.6	<2.5	<1.3	<1.9	<2.9	1.16	0.52
Rancho Cordova	<8.6	<2.8	<7.9	<8.9	<1.9		N.D.
Arden	6.4	<5.6	<4.2	2.5	<7.9	2.8	1.78
Highland Estates	<1.9	<2.6	<1.8	<1.7	<2.4		N.D.
Rio Linda	4.4	7.1	6.0	4.3	5.7	1.14	5.5
C.S.D. #6	<2.0	<3.1	<4.6	<1.7	<2.4		N.D.
Natomas	2.3	1.9	<3.1	<3.8	<5.0	1.16	0.84
Central	2.3	3.8	4.6	1.6	1.5	1.38	2.76
Meadowview	<2.0	<1.8	0.6	<2.6	<2.9	0.27	0.12
City Main	7.5	16	34	<1.8	19	12.83	15.3

Analysis of Influent and Effluent

Treatment Facility		Week[1] μg/l[3]					Summary	
		1	2	3	4	5	Std.[4] Dev.	Average
Central	Influent	1.7	1.0	2.4	0.5	0.6	0.80	1.24
	Effluent	<0.1	<0.1	0.1	0.3	<0.1	0.13	0.08
City Main	Influent	2.1	1.6	4.3	1.6	2.3	1.12	2.38
	Effluent	0.7	0.2	1.9	1.1	0.6	0.64	0.90

[1] Weekly composites of daily samples.
[2] mg/kg on a dry weight basis.
[3] μg/l on a well mixed sample.
[4] Standard Deviation.

APPENDIX B

ANALYTICAL RESULTS

LABORATORY REPORT
BY
BROWN AND CALDWELL
ENVIRONMENTAL SCIENCES DIVISION
JUNE 14, 1977

BROWN AND CALDWELL
CONSULTING ENGINEERS
ENVIRONMENTAL SCIENCES DIVISION

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June 14, 1977

Mr. Al Wolfenden
Sacramento Area Consultants
723 S Street
Sacramento, CA 95814

J231E

TRANSMITTAL OF RESULTS - WEEK # 1 4/17-23/77

Log No:	8C1	8C2	8C3	8C4	8C5
Source of Sample (Sludge):	Northeast	Rancho Cordova	Arden	Highland Estates	Rio Linda
	mg/kg, dry wt				
Arsenic	5.6	55	4.1	12	5.2
Beryllium	< 3.3	< 1.9	< 4.4	< 3.9	< 2.5
Cadmium	3.7	4.3	7.7	5.0	11
Chromium	24	8.7	54	35	96
Copper	100	110	190	180	380
Lead	31	39	23	40	64
Mercury	1.5	0.61	3.5	2.1	5.0
Molybdenum	< 19	< 44	< 39	< 25	< 40
Nickel	7.4	18	23	15	36
Selenium	0.4	0.3	0.7	1.7	0.9
Silver	9.3	4.3	31	2.5	11
Zinc	410	230	500	580	1300
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 1.6	< 8.6	< 4.5	< 1.9	< 3.7
1254	1.6	< 8.6	< 4.5	< 1.9	3.7
Pesticides					
Technical Chlordane	2.6	< 8.6	6.4	< 1.9	4.4
Aldrin	< 1.6	< 8.6	4.5	< 1.9	< 3.7
Percent Total Solids	3.1	0.58	1.1	2.7	2.7

Week # 1 - 4/17-23/77

Log No:	8C6	8C7	8C8	8C9	8C10
Source of Sample (Sludge):	CSD # 6	Natomas	Meadow-view	Central	City Main
	mg/kg, dry wt				
Arsenic	3.3	6.9	3.7	11	7.0
Beryllium	< 3.6	< 2.3	< 2.0	< 2.2	< 2.1
Cadmium	9.1	3.9	4.4	8.3	13
Chromium	20	29	20	92	190
Copper	130	120	120	190	320
Lead	36	33	38	120	140
Mercury	2.4	0.96	2.4	4.0	5.4
Molybdenum	< 23	< 20	< 22	< 21	< 21
Nickel	27	20	20	42	64
Selenium	0.8	0.5	0.4	0.6	1.2
Silver	2.3	2.0	2.2	21	60
Zinc	410	410	420	620	830
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 2.0	< 1.3	< 2.0	< 1.1	< 2.1
1254	2.0	1.5	2.0	1.6	2.9
Pesticides					
Technical Chlordane	< 2.0	2.3	< 2.0	2.3	7.5
Aldrin	< 2.0	< 1.3	< 2.0	< 1.1	< 2.1
Percent Total Solids	2.5	4.0	2.5	4.4	2.4

Week # 1 - 4/17-23/77

Log No: Source of Sample:	8C11 Central Influent	8C12 Central Effluent	8C13 City Main Influent	8C14 City Main Effluent
	mg/l			
Arsenic	0.0076	0.0056	0.0072	0.0088
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	0.05	< 0.01	0.04	0.03
Copper	0.12	0.02	0.11	0.03
Lead	0.08	0.04	0.05	0.05
Mercury	0.0010	0.0004	0.0013	0.0001
Molybdenum	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	0.05	0.07	0.03	0.29
Selenium	0.0028	< 0.0002	0.0006	0.0005
Silver	0.01	< 0.01	0.01	< 0.01
Zinc	0.34	0.07	0.21	0.06
Chlorinated Hydrocarbons:	µg/l			
Polychlorinated Biphenyls				
1242	< 1.0	< 0.2	< 1.0	< 0.4
1254	< 1.0	< 0.2	< 1.0	< 0.4
Pesticides				
Technical Chlordane	1.7	< 0.1	2.1	0.7
Hexachlorobenzene	0.11	< 0.05	< 0.05	< 0.05
Methoxychlor	< 0.1	< 0.1	0.4	0.1

Week # 2 - 4/24-30/77

Log No:	9V1	9V2	9V3	9V4	9V5
Source of Sample (Sludge):	Northeast	Rancho Cordova	Arden	Highland Estates	Rio Linda
	mg/kg, dry wt				
Arsenic	6.4	< 2.8	8.4	3.7	13
Beryllium	< 1.3	< 4.5	< 1.5	< 1.3	< 1.5
Cadmium	2.6	4.5	7.4	3.8	9.1
Chromium	24	18	65	60	95
Copper	99	180	220	180	410
Lead	22	59	24	25	48
Mercury	1.6	1.0	6.8	3.5	6.5
Molybdenum	< 13	< 45	< 15	< 13	< 15
Nickel	13	77	34	28	48
Selenium	0.6	2.7	1.7	1.7	2.6
Silver	7.9	9.1	43	1.2	12
Zinc	400	460	600	610	1300
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 2.5	< 28	< 5.6	< 2.6	< 2.4
1254	< 2.5	< 28	< 5.6	< 2.6	4.3
Pesticides					
Technical Chlordane	< 2.5	< 28	< 5.6	< 2.6	7.1
Hexachlorobenzene	< 0.5	< 5.6	< 1.1	< 0.5	< 0.5
Lindane	< 0.5	< 5.6	< 1.1	< 0.5	< 0.5
Percent Total Solids	2.0	0.18	0.89	1.9	2.1

Week # 2 - 4/24-30/77

Log No:	9V6	9V7	9V8	9V9	9V10
Source of Sample (Sludge):	CSD # 6	Natomas	Meadow-view	Central	City Main
	mg/kg, dry wt				
Arsenic	2.3	8.2	6.4	29	14
Beryllium	< 1.3	< 0.9	< 1.0	< 1.3	< 1.6
Cadmium	1.3	3.6	4.0	9.0	11
Chromium	27	34	20	170	300
Copper	130	110	120	220	360
Lead	22	26	25	97	110
Mercury	2.9	1.7	3.8	4.3	5.3
Molybdenum	< 13	< 8.9	< 10	< 13	< 16
Nickel	18	25	18	27	83
Selenium	0.1	1.0	1.2	1.5	1.8
Silver	3.8	1.8	4.0	21	72
Zinc	450	460	500	720	1000
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 3.1	< 1.9	< 1.8	< 1.9	< 3.1
1254	< 3.1	< 1.9	< 1.8	1.9	4.4
Pesticides					
Technical Chlordane	< 3.1	1.9	< 1.8	3.8	16
Hexachlorobenzene	< 0.6	< 0.4	< 0.4	0.3	< 0.6
Lindane	< 0.6	< 0.4	< 0.4	< 0.3	< 0.6
Percent Total Solids	1.6	2.6	2.8	3.7	1.6

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June 14, 1977
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Week # 2 - 4/24-30/77

Log No:	9V11	9V12	9V13	9V14
Source of Sample:	Central Influent	Central Effluent	City Main Influent	City Main Effluent
	mg/l			
Arsenic	0.0012	0.0014	0.0014	0.0018
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	0.02	0.02	0.03	0.04
Copper	0.05	0.02	0.05	0.03
Lead	0.10	0.07	0.05	0.05
Mercury	0.0003	< 0.0001	0.0007	0.0025
Molybdenum	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	0.10	0.08	0.07	0.26
Selenium	0.0006	0.0001	0.0001	0.0001
Silver	< 0.01	< 0.01	0.01	0.01
Zinc	0.15	0.06	0.09	0.06
Chlorinated Hydrocarbons:	µg/l			
Polychlorinated Biphenyls				
1242	< 0.2	< 0.2	< 0.2	< 0.2
1254	0.38	< 0.2	< 0.2	< 0.2
Pesticides				
Technical Chlordane	1.0	< 0.1	1.6	0.2
Hexachlorobenzene	0.09	0.05	< 0.05	< 0.05
Lindane	0.1	< 0.05	< 0.05	< 0.05

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Week # 3 - 5/01-07/77

Log No:	11K1	11K2	11K3	11K4	11K5
Source of Sample (Sludge):	Northeast	Rancho Cordova	Arden	Highland Estates	Rio Linda
	mg/kg, dry wt				
Arsenic	11	< 1.0	8.6	4.0	13
Beryllium	< 0.7	< 1.3	< 1.4	< 1.0	< 1.7
Cadmium	1.4	2.6	2.7	2.9	8.3
Chromium	26	12	43	46	100
Copper	100	90	160	150	400
Lead	14	13	19	24	67
Mercury	2.4	0.89	3.9	4.7	6.2
Molybdenum	< 7.1	< 13	< 14	< 9.6	< 17
Nickel	14	15	19	16	37
Selenium	0.26	0.98	0.18	1.3	0.71
Silver	8.6	6.4	30	1.0	10
Zinc	370	220	430	530	1400
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 1.3	< 7.9	< 4.2	< 1.8	< 2.5
1254	< 1.3	< 7.9	< 4.2	< 1.8	< 2.5
Pesticides					
Technical Chlordane	< 1.3	< 7.9	< 4.2	< 1.8	6.0
Hexachlorobenzene	< 0.3	< 1.6	0.8	< 0.4	< 0.5
Lindane	< 0.3	< 1.6	< 0.8	< 0.4	< 0.5
Percent Total Solids	3.8	0.63	1.2	2.7	2.0

Week # 3 - 5/01-07/77

Log No:	11K6	11K7	11K8	11K9	11K10
Source of Sample (Sludge):	CSD # 6	Natomas	Meadow-view	Central	City Main
	mg/kg, dry wt				
Arsenic	6.3	237	4.0	8.9	21
Beryllium	< 1.0	< 1.1	< 5.8	< 1.1	< 1.7
Cadmium	1.0	2.2	2.3	72	10
Chromium	24	66	35	110	280
Copper	120	130	150	200	320
Lead	17	29	22	30	52
Mercury	1.7	2.0	3.3	4.2	5.3
Molybdenum	< 9.8	< 11	< 5.8	< 11	< 17
Nickel	20	37	16	41	92
Selenium	0.89	0.70	0.20	1.1	1.1
Silver	4.9	3.3	2.3	20	58
Zinc	380	520	370	620	920
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 4.6	< 3.1	< 0.6	< 2.1	< 2.2
1254	< 4.6	< 3.1	< 0.6	2.9	4.4
Pesticides					
Technical Chlordane	< 4.6	< 3.1	0.6	4.6	34
Hexachlorobenzene	< 0.9	< 0.6	< 0.1	0.4	< 0.4
Lindane	< 0.9	< 0.6	< 0.1	< 0.4	< 0.4
Percent Total Solids	1.1	1.6	7.8	4.4	2.3

Week # 3 - 5/01-07/77

Log No:	11K11	11K12	11K13	11K14
Source of Sample:	Central Influent	Central Effluent	City Main Influent	City Main Effluent
	mg/l			
Arsenic	0.0026	0.0015	0.0024	0.0017
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	< 0.01	< 0.01	0.03	< 0.01
Copper	0.08	0.02	0.06	0.02
Lead	0.06	0.04	0.02	0.04
Mercury	0.0005	0.0001	0.0004	0.0004
Molybdenum	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	0.06	0.08	0.15	0.23
Selenium	0.0006	0.0003	0.0006	0.0004
Silver	< 0.01	< 0.01	< 0.01	0.02
Zinc	0.15	0.08	0.11	0.07
Chlorinated Hydrocarbons:	µg/l			
Polychlorinated Biphenyls				
1242	< 0.02	< 0.02	< 0.02	< 0.02
1254	< 0.02	< 0.02	< 0.02	< 0.02
Pesticides				
Technical Chlordane	2.4	0.1	4.3	1.9
Hexachlorobenzene	0.05	< 0.05	< 0.05	< 0.05
Lindane	0.07	< 0.05	< 0.05	< 0.05

Week # 4 - 5/08-14/77

Log No:	12Y1	12Y2	12Y3	12Y4	12Y5
Source of Sample (Sludge):	Northeast	Rancho Cordova	Arden	Highland Estates	Rio Linda
	mg/kg, dry wt				
Arsenic	6.6	1.9	5.2	4.5	14
Beryllium	< 1.1	< 1.2	< 1.1	< 0.9	< 1.3
Cadmium	2.2	1.2	2.3	2.8	6.2
Chromium	26	4.8	41	46	66
Copper	98	45	170	150	250
Lead	13	9.5	6.8	11	25
Mercury	2.6	0.35	3.1	2.0	3.6
Molybdenum	< 11	< 12	< 11	< 9.2	< 13
Nickel	16	12	20	19	31
Selenium	< 0.08	< 0.36	0.73	< 0.07	< 0.07
Silver	9.8	2.4	49	2.8	8.8
Zinc	430	120	470	510	920
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 1.9	< 8.9	< 2.5	< 1.7	< 1.8
1254	< 1.9	< 8.9	< 2.5	< 1.7	2.5
Pesticides					
Technical Chlordane	< 1.9	< 8.9	2.5	< 1.7	4.3
Hexachlorobenzene	< 0.4	< 1.8	< 0.5	< 0.3	< 0.4
Lindane	< 0.4	< 1.8	1.0	< 0.3	< 0.4
Percent Total Solids	2.6	0.56	2.0	2.9	2.8

Week # 4 - 5/08-14/77

Log No:	12Y6	12Y7	12Y8	12Y9	12Y10
Source of Sample (Sludge):	CSD # 6	Natomas	Meadow-view	Central	City Main
	mg/kg, dry wt				
Arsenic	6.4	8.2	9.7	19	18
Beryllium	< 0.8	< 0.9	< 0.9	< 0.8	< 1.1
Cadmium	2.5	2.8	2.6	43	7.6
Chromium	27	20	18	92	160
Copper	120	67	110	180	280
Lead	15	13	16	63	49
Mercury	2.3	0.66	2.6	2.8	4.0
Molybdenum	< 8.3	< 9.3	< 8.8	< 8.3	< 11
Nickel	21	17	24	68	160
Selenium	< 0.07	0.85	1.05	0.56	0.43
Silver	2.5	1.9	3.5	15	49
Zinc	360	300	400	490	640
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 1.7	< 3.8	< 2.6	< 1.1	< 1.8
1254	< 1.7	< 3.8	< 2.6	1.3	< 1.8
Pesticides					
Technical Chlordane	< 1.7	< 3.8	< 2.6	1.6	< 1.8
Hexachlorobenzene	< 0.3	< 0.8	< 0.5	< 0.2	< 0.4
Lindane	< 0.3	< 0.8	< 0.5	< 0.2	< 0.4
Percent Total Solids	2.9	1.3	1.9	4.5	2.8

Week # 4 - 5/08-14/77

Log No:	12Y11	12Y12	12Y13	12Y14
Source of Sample:	Central Influent	Central Effluent	City Main Influent	City Main Effluent
	mg/l			
Arsenic	0.0024	0.0004	0.0051	0.0014
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	0.03	< 0.01	0.03	0.02
Copper	0.08	0.01	0.05	0.02
Lead	0.05	0.02	0.06	0.05
Mercury	0.0007	< 0.0001	0.0010	0.0002
Molybdenum	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	0.16	0.12	0.12	0.26
Selenium	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Silver	< 0.01	< 0.01	0.01	< 0.01
Zinc	0.22	0.07	0.16	0.06
Chlorinated Hydrocarbons:	µg/l			
Polychlorinated Biphenyls				
1242	< 0.2	< 0.2	< 0.2	< 0.2
1254	0.3	< 0.2	< 0.2	< 0.2
Pesticides				
Technical Chlordane	0.5	0.3	1.6	1.1
Hexachlorobenzene	< 0.05	< 0.05	< 0.05	< 0.05
Lindane	0.06	< 0.05	0.05	< 0.05

Week # 5 - 5/15-21/77

Log No:	15D1	15D2	15D3	15D4	15D5
Source of Sample (Sludge):	Northeast	Rancho Cordova	Arden	Highland Estates	Rio Linda
	mg/kg, dry wt				
Arsenic	9.2	3.6	13	6.5	26
Beryllium	< 1.0	< 2.2	< 3.3	< 1.0	< 1.5
Cadmium	4.2	2.2	6.7	5.9	14
Chromium	24	6.5	70	49	100
Copper	100	96	270	180	350
Lead	28	13	20	24	58
Mercury	2.6	1.0	6.8	2.2	6.6
Molybdenum	< 10	< 23	< 33	< 9.8	< 15
Nickel	10	4.3	33	13	39
Selenium	1.5	2.3	3.8	2.9	3.6
Silver	10	6.5	60	2.0	12
Zinc	460	240	800	550	1400
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 2.9	< 19	< 7.9	< 2.4	< 2.8
1254	< 2.9	< 19	< 7.9	< 2.4	< 2.8
Pesticides					
Technical Chlordane	< 2.9	< 19	< 7.9	< 2.4	5.7
Hexachlorobenzene	< 0.6	< 3.7	1.6	< 0.5	< 0.6
Lindane	0.6	< 3.7	< 1.6	< 0.5	< 0.6
Percent Total Solids	1.7	0.27	0.63	2.1	1.8

Week # 5 - 5/15-21/77

Log No:	15D6	15D7	15D8	15D9	15D10
Source of Sample (Sludge):	CSD # 6	Natomas	Meadow-view	Central	City Main
	mg/kg, dry wt				
Arsenic	5.1	8.6	5.7	13	21
Beryllium	< 1.0	< 1.3	< 1.1	< 1.0	< 1.1
Cadmium	4.2	5.1	2.2	12	11
Chromium	18	28	19	110	220
Copper	94	92	130	190	350
Lead	18	18	18	40	110
Mercury	1.8	0.9	3.2	3.3	5.6
Molybdenum	< 10	< 13	< 11	< 10	< 11
Nickel	14	19	12	54	120
Selenium	0.7	1.1	0.8	1.1	2.4
Silver	3.1	1.3	3.2	15	73
Zinc	310	380	420	660	900
Chlorinated Hydrocarbons:					
Polychlorinated Biphenyls					
1242	< 2.4	< 5.0	< 2.9	< 1.1	< 2.3
1254	< 2.4	< 5.0	2.9	1.1	3.6
Pesticides					
Technical Chlordane	< 2.4	< 5.0	< 2.9	1.5	19
Hexachlorobenzene	< 0.5	< 1.0	< 0.6	< 0.2	< 0.5
Lindane	< 0.5	< 1.0	< 0.6	< 0.2	< 0.5
Percent Total Solids	2.1	1.0	1.7	4.6	2.2

Log No: Source of Sample:	15D11 Central Influent	15D12 Central Effluent	15D13 City Main Influent	15D14 City Main Effluent
	mg/l			
Arsenic	0.0040	0.0007	0.0027	0.0008
Beryllium	< 0.01	< 0.01	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	0.02	< 0.01	0.04	0.02
Copper	0.05	0.01	0.04	0.03
Lead	0.05	< 0.01	0.02	< 0.01
Mercury	0.0003	< 0.0001	0.0009	0.0002
Molybdenum	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	0.07	0.03	0.03	0.17
Selenium	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Silver	< 0.01	< 0.01	< 0.01	< 0.01
Zinc	0.14	0.05	0.11	0.06
Chlorinated Hydrocarbons:	µg/l			
Polychlorinated Biphenyls				
1242	< 0.2	< 0.2	< 0.2	< 0.2
1254	0.2	< 0.2	< 0.2	< 0.2
Pesticides				
Technical Chlordane	0.6	< 0.1	2.3	0.6
Hexachlorobenzene	< 0.05	< 0.05	< 0.05	< 0.05
Lindane	0.08	< 0.05	0.05	< 0.05

Analytical procedures are in accordance with those published in the Federal Register, Title 40 Part 136; "Guidelines Establishing Test Procedures for Analysis of Pollutants".

Reported by ____________
Steven A. Fisher
Laboratory Supervisor

APPENDIX C

IWS LOCAL SOURCE CONTROL PROGRAM
SEMI-ANNUAL REPORT
JANUARY THROUGH JUNE 1977

COUNTY OF SACRAMENTO
WATER QUALITY CONTROL LABORATORIES
3711 Branch Center Road
Sacramento, CA 95827

IWS Local Source Control Program
Semi-Annual Report

January thru June, 1977

Laboratory No.	031399	040455	041453	031052
Sample Station	Almond Growers	American Poultry	Campbell Soup	Chef's Best
Arsenic (As) μg/l	4	2	3	1
Cadmium (Cd) μg/l	38	6	34	9
Chromium (T) (Cr) μg/l	36	11	28	12
Copper (Cu) μg/l	45	27	37	10
Lead (Pb) μg/l	17	28	16	16
Mercury (Hg) μg/l	1	1	2	1
Silver (Ag) μg/l	5	4	5	13
Zinc (Zn) μg/l	80	80	87	38
Ammonia Nitrogen as N, mg/l	5.9	12.0	14.1	5.0
Cyanide μg/l	5900	530	950	<100
Phenols, μg/l	52	5	0	5
Chlorinated Hydrocarbons, μg/l	12.1	0.8	6.1	1.0
Radioactivity:				
Gross Beta, pCi/l	167	10	16	16
Gross Alpha, pCi/l	<3	<3	<3	<3

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Laboratory No.	030427	030060	030429	020439
Sample Station	Claus & Kraus	Coca Cola	Community Linen	Crystal Creamery
Arsenic (As) μg/l	0.4	2.1	0.8	3
Cadmium (Cd) μg/l	30	59	50	10
Chromium (T) (Cr) μg/l	9	51	65	10
Copper (Cu) μg/l	24	79	78	63
Lead (Pb) μg/l	18	45	35	55
Mercury (Hg) μg/l	0.5	0.7	1	1.2
Silver (Ag) μg/l	8	7	37	1
Zinc (Zn) μg/l	130	340	280	570
Ammonia Nitrogen as N, mg/l	3.5	0.7	0.6	1.4
Cyanide μg/l	<100	<100	170	100
Phenols, μg/l	52	0	27	2
Chlorinated Hydrocarbons, μg/l	0.3	0.3	0	4.1
Radioactivity:				
Gross Beta, pCi/l	14	10	14	41
Gross Alpha, pCi/l	<3	<3	<3	<3

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Laboratory No.	020440	020441	031932	020210
Sample Station	Folsom City of	Folsom Prison	Foremost Dairy	Keyes Fibre
Arsenic (As) µg/l	2	<1	2	<1
Cadmium (Cd) µg/l	8	7	24	1
Chromium (T) (Cr) µg/l	9	5	16	11
Copper (Cu) µg/l	90	52	28	41
Lead (Pb) µg/l	64	34	12	23
Mercury (Hg) µg/l	0.7	0.1	1	0.1
Silver (Ag) µg/l	20	5	16	3
Zinc (Zn) µg/l	230	80	88	210
Ammonia Nitrogen as N, mg/l	20.2	3.6	0.8	1.4
Cyanide µg/l	360	650	<100	150
Phenols, µg/l	94	8	1	0
Chlorinated Hydrocarbons, µg/l	2.0	1.6	1.9	0
Radioactivity:				
Gross Beta, pCi/l	-	-	80	<3
Gross Alpha, pCi/l	-	-	<3	<2

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Laboratory No. Sample Station	041451 Libby-McNeil-Libby	020437 Made-rite Broadway	020436 Made-rite 34th St.	020213 Meridith Fish
Arsenic (As) µg/l	7	<1	2	3
Cadmium (Cd) µg/l	18	10	8	11
Chromium (T) (Cr) µg/l	26	7	10	15
Copper (Cu) µg/l	52	51	78	130
Lead (Pb) µg/l	22	59	87	65
Mercury (Hg) µg/l	3	0.2	0.7	0.7
Silver (Ag) µg/l	5	4	12	3
Zinc (Zn) µg/l	170	390	520	890
Ammonia Nitrogen as N, mg/l	8.5	5.0	5.5	43.8
Cyanide µg/l	950	470	650	1700
Phenols, µg/l	14	3	11	8
Chlorinated Hydrocarbons, µg/l	23	0.6	0.8	0.3
Radioactivity:				
Gross Beta, pCi/l	19	16	<10	<17
Gross Alpha, pCi/l	<3	<3	<16	<20

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Laboratory No.	030428	030059	020438	020211
Sample Station	National Linen	Pepsi Cola	Pop Shoppe	Procter & Gamble
Arsenic (As) µg/l	1.1	6.5	<1	<1
Cadmium (Cd) µg/l	57	360	230	18
Chromium (T) (Cr) µg/l	36	560	59	26
Copper (Cu) µg/l	102	440	530	160
Lead (Pb) µg/l	73	470	730	94
Mercury (Hg) µg/l	1.7	4.6	0.3	0.2
Silver (Ag) µg/l	11	150	17	24
Zinc (Zn) µg/l	440	1400	1360	120
Ammonia Nitrogen as N, mg/l	1.0	0.3	5.6	0.3
Cyanide µg/l	150	110	<100	300
Phenols, µg/l	50	0	14	4
Chlorinated Hydrocarbons, µg/l	0	1.0	1.2	0
Radioactivity:				
Gross Beta, pCi/l	6	8	43	<10
Gross Alpha, pCi/l	<3	<3	<15	<20

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Laboratory No.	020212	040869	020216	030714
Sample Station	Red Star Ind. Service	Royal Crown	Sacramento Army Depot	Sacramento State College
Arsenic (As) μg/l	6	3	2	3
Cadmium (Cd) μg/l	92	7	86	30
Chromium (T) (Cr) μg/l	210	41	150	25
Copper (Cu) μg/l	490	57	81	66
Lead (Pb) μg/l	1360	12	39	28
Mercury (Hg) μg/l	1.3	2	0.6	1.0
Silver (Ag) μg/l	8	1	27	24
Zinc (Zn) μg/l	1860	61	250	130
Ammonia Nitrogen as N, mg/l	0.1	2.2	2.0	24.6
Cyanide μg/l	<100	150	7600	240
Phenols, μg/l	52	1	47	47
Chlorinated Hydrocarbons, μg/l	6.1	0.6	0.6	6.9
Radioactivity:				
Gross Beta, pCi/l	10	30	8	-
Gross Alpha, pCi/l	<10	<7	<2	-

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Laboratory No.	020217	020214	031934	051554
Sample Station	Safeway Dist. Center	Setzer Box	Seven-Up Bottling Co.	Shasta Linen
Arsenic (As) µg/l	3	<1	1	2
Cadmium (Cd) µg/l	12	3	14	15
Chromium (T) (Cr) µg/l	25	8	17	22
Copper (Cu) µg/l	93	35	30	25
Lead (Pb) µg/l	150	40	84	52
Mercury (Hg) µg/l	1.4	0.2	1	2
Silver (Ag) µg/l	7	3	27	5
Zinc (Zn) µg/l	610	80	63	120
Ammonia Nitrogen as N, mg/l	4.5	1.7	1.4	1.8
Cyanide µg/l	<100	<100	200	150
Phenols, µg/l	5	0	4	0
Chlorinated Hydrocarbons, µg/l	1.3	0	0.8	1.6
Radioactivity:				
Gross Beta, pCi/l	18	3	31	<3
Gross Alpha, pCi/l	<3	<3	<7	<3

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Laboratory No.	041248	041299	031935	031050
Sample Station	Southern Pacific RR	Technicolor	Union Carbide	Vita Freeze
Arsenic (As) μg/l	2	3	4	4
Cadmium (Cd) μg/l	22	25	46	14
Chromium (T) (Cr) μg/l	38	55	22	35
Copper (Cu) μg/l	36	52	19	47
Lead (Pb) μg/l	63	83	18	65
Mercury (Hg) μg/l	3	4	2	3
Silver (Ag) μg/l	3	22	31	10
Zinc (Zn) μg/l	363	402	130	382
Ammonia Nitrogen as N, mg/l	0.3	0.4	1.7	5.3
Cyanide μg/l	470	1080	190	190
Phenols, μg/l	280	7	22,300	0
Chlorinated Hydrocarbons, μg/l	3.1	0	0	1.3
Radioactivity:				
Gross Beta, pCi/l	7	520	<7	92
Gross Alpha, pCi/l	<12	<6	<7	<3

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Laboratory No.	020215	020196	020179	030597
Sample Station	Western Pacific RR	Arden T/P	Central T/P	City Main T/P
Arsenic (As) µg/l	3	2	4	1.5
Cadmium (Cd) µg/l	5	5	7	50
Chromium (T) (Cr) µg/l	16	20	82	47
Copper (Cu) µg/l	68	80	110	81
Lead (Pb) µg/l	96	100	72	34
Mercury (Hg) µg/l	0.8	0.7	2.4	1.2
Silver (Ag) µg/l	4	15	13	27
Zinc (Zn) µg/l	140	290	390	360
Ammonia Nitrogen as N, mg/l	6.3	19	18	19
Cyanide µg/l	150	650	1800	3000
Phenols, µg/l	140	390	980	540
Chlorinated Hydrocarbons, µg/l	0.5	5.8	12.3	10.5
Radioactivity:				
Gross Beta, pCi/l	5	16	10	16
Gross Alpha, pCi/l	<2	<3	<3	<3

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Laboratory No.	030034	031759	041452	020372
Sample Station	Cordova T/P	Highlands T/P	Meadowview T/P	Natomas T/P
Arsenic (As) µg/l	6.7	2	3	6
Cadmium (Cd) µg/l	1200	54	13	10
Chromium (T) (Cr) µg/l	930	55	46	16
Copper (Cu) µg/l	540	53	42	97
Lead (Pb) µg/l	340	63	34	320
Mercury (Hg) µg/l	2.8	3	2	1.1
Silver (Ag) µg/l	170	37	9	1
Zinc (Zn) µg/l	1300	180	98	320
Ammonia Nitrogen as N, mg/l	24	18.5	22.5	28.3
Cyanide µg/l	3600	370	1020	950
Phenols, µg/l	490	290	810	520
Chlorinated Hydrocarbons, µg/l	11.1	5.1	8.1	8.1
Radioactivity:				
Gross Beta, pCi/l	24	14	8	15
Gross Alpha, pCi/l	<3	<3	<2	<3

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Laboratory No.	020204	030063	032106	020376
Sample Station	Northeast T/P	Northeast Export	Rio Linda T/P	San #6 T/P
Arsenic (As) μg/l	3	8.5	3	1
Cadmium (Cd) μg/l	2	84	22	2
Chromium (T) (Cr) μg/l	14	72	47	10
Copper (Cu) μg/l	80	310	34	140
Lead (Pb) μg/l	42	70	44	36
Mercury (Hg) μg/l	2.4	6.7	1	0.4
Silver (Ag) μg/l	8	44	24	3
Zinc (Zn) μg/l	190	1200	99	260
Ammonia Nitrogen as N, mg/l	22	111	21.8	26
Cyanide μg/l	480	360	530	810
Phenols, μg/l	600	390	540	810
Chlorinated Hydrocarbons, μg/l	10.1	16.3	12.1	4.2
Radioactivity:				
Gross Beta, pCi/l	12	-	13	16
Gross Alpha, pCi/l	<3	-	<3	<3

- Not Tested

Reported by: Edward H. Chow
Laboratory Director

Reported to: Larry Bristow
IWS

Report Date: 7-1-77

APPENDIX D

CHLORINATED HYDROCARBONS ANALYTICAL SCHEDULE

CHLORINATED HYDROCARBONS
ANALYTICAL SCHEDULE

Aldrin

BHC isomeres
  includes Lindane

Chlordane

DDD (TDE)

DDE

DDT

Dieldrin

Endrin

Heptachlor

Heptachlor epoxide

Methoxychlor

Toxaphene

Polychlorinated biphenyls (PCBs)
  PCB 1242
  PCB 1254

FINAL TASK REPORT
SOURCE SURVEY, PHASE II

SEWAGE SLUDGE MANAGEMENT PROGRAM

SEPTEMBER 21, 1979

Prepared for
SACRAMENTO AREA CONSULTANTS
Sacramento, California

By

Warren R. Uhte
SAC Project Manager

and

Allen K. Wolfenden
SAC Project Engineer

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APPENDIX A

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CHAPTER 1

INTRODUCTION

This chapter presents a summary of the Phase I Source Survey and a review of the Phase I recommendations. The implementation of these recommendations was limited due to the promulgation of "General Pretreatment Regulations for Existing and New Sources of Pollution" (40 CFR, Part 403). The regulations called for much more extensive source identification and monitoring programs than had been scoped for Phase II of the Source Survey. Therefore, it was decided to limit the implementation of Phase II to analysis of selected stored daily samples and to incorporate other actions into the comprehensive Pretreatment Program. Grant funds will be available to develop the Pretreatment Program.

Authorizations

This report was prepared in accordance with Subtask 3.1 or similarly described as Subtask G of the Sewage Sludge Management Program (SSMP). The work plan for this report was presented in the May 30, 1978 Recommended Program Revisions formally adopted as Amendment 10C to the SSMP. In subsequent discussions with the District, the work plan was amended as discussed in the following sections.

Phase I Summary

The Phase I SSMP Source Survey was conducted to determine the amounts of heavy metals and chlorinated hydrocarbons being discharged to Sacramento Regional County Sanitation District (SRCSD) treatment plants. Raw sludge samples were collected daily for five weeks (April 17 through May 21, 1977) at 10 SRCSD treatment plants. At two of these plants, Central and City Main, influent and effluent samples were also collected. Composites were made of each weekly series of samples and these were analyzed for 12 heavy metals and an array of chlorinated hydrocarbons. An estimated domestic heavy metal load was developed for each plant and was compared to the measured heavy metal load. This study revealed those treatment plants that are receiving excessive levels of heavy metals.

A range of domestic per capita loads were developed for each heavy metal based on data from Northeast, Highland Estates, CSD #6, and Meadowview treatment plants. The domestic unit loads were used to develop an estimated total domestic load to determine which plants receive excessive discharges of heavy metals.

The ratios of average plant heavy metal loads, as measured in the raw sludges, to the plant's estimated domestic load are shown in Table 1-1.

Table 1-1. Ratios of Plant Loads to Estimated Domestic Loads

Heavy metal	Ratios[a]					
	Central	City Main	Rancho Cordova	Arden	Rio Linda	Natomas
Arsenic	1.8	4.0	3.3	1.3	4.0	10.0
Beryllium[b]	0	0	0	0	0	0
Cadmium	2.9	1.8	<1	<1	1.8	<1
Chromium	3.3	10.0	<1	2.0	6.7	1.7
Copper	1.3	4.0	1.5	1.7	5.0	1.1
Lead	1.3	4.0	1.3	<1	2.5	<1
Mercury	<1	2.9	<1	1.7	3.3	<1
Molybdenum[b]	0	0	0	0	0	0
Nickel	1.3	6.7	1.7	<1	2.5	1.1
Selenium	<1	1.4	1.4	<1	1.7	<1
Silver	1.8	10.0	1.3	5.0	2.5	<1
Zinc	1.1	2.9	<1	1.3	5.0	1.2

[a] Ratio of average plant load for five weeks sampled to estimated domestic load based on raw sludge data.

[b] Metals not detected in either raw sludges or influents.

The ratios presented in Table 1-1 are classified into three classes as presented in Table 1-2. Class 2 and 3 levels are further divided to indicate which heavy metals have an identified source. Group A signifies an identified source and Group B an unidentified source. The identified sources are among those industries that are currently monitored by the Sacramento County Industrial Waste Section. For the Central plant, the currently monitored industries appear to be the sources of the measured heavy metal load. For the City Main plant, however, the currently monitored industries do not account for the measured heavy metal loads.

Table 1-2. Summary of Ratios of Plant Loads to Estimated Domestic Loads

Heavy metal	Classifications of heavy metal loads					
	Central	City Main	Rancho Cordova	Arden	Rio Linda	Natomas
Arsenic	1	3B	2A	1	3B	3B
Beryllium	1	1	1	1	1	1
Cadmium	2A	1	1	1	1	1
Chromium	2A	3B	1	1	3B	1
Copper	1	3B	1	1	3B	1
Lead	1	3B	1	1	2B	1
Mercury	1	2A	1	1	2B	1
Molybdenum	1	1	1	1	1	1
Nickel	1	3B	1	1	2B	1
Selenium	1	1	1	1	1	1
Silver	1	3B	1	3B	2B	1
Zinc	1	2A	1	1	3B	1

Definitions of Classifications

Class. 1	Heavy metal load not significantly in excess of domestic levels (ratio less than or equal to 2).[a]
Class. 2	Heavy metal load moderately in excess of domestic levels (ratio between 2 and 3.5).[a]
Class. 2A	Load accounted for by currently monitored industries.
Class. 2B	Load not accounted for by currently monitored industries.
Class. 3	Heavy metal load greatly in excess of domestic levels (ratio greater than 3.5).[a]
Class. 3A	Same as 2-A (above).
Class. 3B	Same as 2-B (above).

[a] Ratio of average plant load (for five weeks sampled) to estimated domestic load based on raw sludge data (Table -1).

Chlorinated hydrocarbons were also measured in the raw sludges, influents, and effluents on the same schedule as heavy metals. It was determined that there is no consistent detectable load of chlorinated hydrocarbons in domestic wastewaters. Concentrations of chlorinated hydrocarbons in Central and City Main were compared to the Proposed Primary Drinking Water Standards, and in all but one week, the measured concentrations in Central and City Main influents were significantly less. Similarly, the concentrations of chlorinated hydrocarbons in the raw sludges were low enough to qualify the sludge as a Class I sludge as described by the California State Department of Health.

The following conclusions were drawn from Phase I of the SSMP Source Survey:

1. Central and City Main heavy metal loads are in excess of domestic loads.
2. Central heavy metal loads can generally be accounted for by measured loads in effluents of currently monitored industries.
3. City Main heavy metal loads cannot generally be accounted for by measured loads in effluents of currently monitored industries.
4. Periodically, excessive loads of one or two heavy metals were detected in raw sludges of Rancho Cordova, Arden Rio Linda, and Natomas.

Phase I Recommendations. Recommendations for continuation of the SSMP Source Survey were limited to those tasks which would help identify the principal sources of heavy metal and chlorinated hydrocarbon discharges to the SRCSD collection system, and would more accurately determine the magnitude of these discharges. Only after the magnitude and sources of the discharges have been documented, can it be determined whether it is appropriate and cost-effective to undertake source control programs for heavy metals or chlorinated hydrocarbons. Any source control measures must, of course, be considered in relation to the impact they would have on industry, Regional Plant effluent, and final sludge disposal.

It was concluded that the following tasks should be completed in Phase II of the SSMP Source Survey; most all of this work could be completed by the Water Quality Division Industrial Waste Section:

1. The currently unidentified sources of arsenic, chromium, copper, lead, nickel, and silver discharged to the City Main system should be identified. Plating industries are a potential source of these heavy metals. Additional monitoring, including measurement of the quantity of wastewater from these industries, is needed. Analysis should also be conducted of municipal water supplies from both river and well sources.
2. Sampling programs should be designed to verify that the suspected sources of heavy metal discharges to Central

are accurate. It appears that Campbell Soup Company may be the principal source of excessive levels of cadmium and chromium measured at Central. Confirmation of this will require coordinated sampling of Campbell Soup effluent and Central influent.

3. Sources of arsenic at Rancho Cordova and Natomas should be investigated as should sources of heavy metals at Rio Linda. However, when considered in relation to the overall regional system loads, the masses of heavy metals discharged to Rancho Cordova, Arden, Rio Linda, and Natomas, are not highly significant.

4. Analysis of some daily samples of raw sludge, influents, and effluents in freezer storage should be performed. These analyses would indicate whether the discharge was relatively constant or variable through the week. Only two sets of samples merit reanalysis:

    a. Daily effluent samples at City Main for all five weeks had higher measured concentrations of lead and nickel than the influent and, therefore, the influent and effluent samples should be reanalyzed for lead and nickel.

    b. Raw sludge samples at Central for Weeks 3 and 4 should be reanalyzed for cadmium to see if they reflect peak day discharges or high levels for the entire week.

    It is not likely that analysis of any additional samples would influence the course of action outlined in these recommendations.

Phase II Scope

In Phase II, it was proposed that SAC would provide management and coordination of the sampling and analytical program developed to investigate Tasks 1, 2, and 3 of the Phase I recommendations. In addition, SAC would analyze the stored samples as recommended in Task 4 and the Phase I recommendations.

Since development of the Phase II work plan, the Environmental Protection Agency (EPA) promulgated the "General Pretreatment Regulations for New Sources of Pollution" (40 CFR, Part 403). These regulations require the District to implement a

Pretreatment Program which, in its implementation, would have resulted in evaluating the pollution sources that were to be investigated under Tasks 1, 2, and 3. Since portions of the proposed work can be incorporated into the more comprehensive Pretreatment Program, it was therefore concluded that it was not necessary to proceed with most of the recommendations of the Phase I report at this time. The District did initiate some additional monitoring of the electroplaters for which point source standards have been proposed. The District shared the analytical results with the electroplaters and also initiated discussions with the trade association in preparation for development of the mandated Pretreatment Program. The next section provides a review of the General Pretreatment Regulations and related studies that the District is currently undertaking.

Pretreatment Regulations

The EPA-Natural Resources Defense Council settlement agreement of June 7, 1976, provided for the development and publication of water quality criteria for 65 groups of toxic substances and for the promulgation of effluent guidelines for 21 categories of industrial discharges. On June 26, 1978, EPA proposed regulations (40 CFR Part 403) for the control of toxic pollutants to publicly owned treatment works (POTWs). All POTWs with average daily flows in excess of 5 mgd, which receive industrial wastes subject to the National Pretreatment Standards, will be required to establish pretreatment programs by 1983 or within 3 years after amendment of an NPDES permit.

Implementation of a Pretreatment Program will also be linked to the construction grant program. Grantees who have received Step 1 and 2 grants before June 30, 1980, and a Step 3 grant before December 31, 1980, must have an approved Pretreatment Program before they receive the last 10% of Step 3 grant funding. Grantees who have received Step 1 and 2 grants before June 30, 1980, and will receive a Step 3 grant after December 31, 1980, must have an approved Pretreatment Program before they can receive any Step 3 funding. Grantees who will receive a Step 2 grant after June 30, 1980, must have performed an industrial use survey, demonstrated implementing authority, and developed an ordinance prior to issuance of Step 2 monies and must have an approved Pretreatment Program to receive any Step 3 funding.

The establishment and enforcement of the local pretreatment programs will be required by the NPDES permit. As part of the pretreatment program, the POTW authority must do the following:

- Identify all industrial contributors through an industrial waste survey.
- Ensure technologies needed to meet standards are installed by industries.
- Ensure compliance with EPA standards.
- Take appropriate enforcement action against violations.

The POTW authority may apply for a removal allowance if consistent removal of a pollutant by the treatment processes is demonstrated. Consistent removal is defined as removal 95 percent of the time. Dilution will not be considered as removal. The discharge of the pollutant from the POTW must be less than or equal to the discharge if each industrial contributor was treating with best available technology economically achievable. A removal allowance will not be granted if the sludge disposal method is adversely affected by the priority pollutant under consideration. Additional monitoring will be required if a removal allowance is obtained. Appendix A presents a summary of the Federal regulations published to date relating to pretreatment of industrial wastes.

As a result of a May 1979 Manufacturing Chemists Association - Environmental Protection Agency Settlement Agreement, several provisions of the pretreatment regulations will be affected. These changes fall into six areas: (1) the definition of Interference and the description of certain prohibited discharges; (2) the definition of Consistent Removal and the methodology by which a POTW may demonstrate such removal; (3) bypassing by POTWs of untreated waste and the ability to obtain revised discharge limits; (4) the general scheme for authorizing POTWs to revise discharge limits, including procedures which allow the POTW to grant conditional credits before a pretreatment program is approved and before new or modified facilities begin discharging pollutants and procedures for applying more frequently for authorization to revise such limits; (5) the addition of procedural guarantees in a number of provisions so that industrial users will be given notice and an opportunity to respond before action is taken that may affect them adversely; and (6) the variance provisions of the regulations. The sections of the

General Pretreatment Regulations (40 CFR, Part 403) affected by this settlement will be revised and the revisions published in the Federal Register early in 1980.

Implementation Schedule

For SRCSD the implementation schedule for the pretreatment program will be dictated by the award dates of Step 1, Step 2, and Step 3 grants for the Phase II Solids Processing and Disposal Facilities (Grant No. C-06-0938-320). The pretreatment regulations direct that if the Step 1 and Step 2 grants are awarded prior to June 3, 1980, and the Step 3 grant is awarded before December 31, 1980, then the pretreatment program must be approved prior to payment of the final 10 percent of the Step 3 grant.

An approximate schedule for completion of the pretreatment program is as shown on Figure 1-1.

Toxicant Monitoring Program

To aid in development of an industrial pretreatment program, the District and SAC conducted a study on the toxic pollutants in Sacramento area wastewaters. Samples were collected at the headworks of the City Main and Central treatment plants, the Central Plant effluent, and the Sacramento River. Since most industry is located in the City Main and Central service areas, the two influent samples gave a good indication of which priority pollutants were being discharged to the collection systems within the Regional District. The Central effluent sample provided a general indication of the level of removal that can be obtained at the Regional Plant and the levels of toxic pollutants that were discharged. The Sacramento River sample provided data on receiving water conditions.

Samples were collected approximately weekly for four weeks. All samples were analyzed for the complete list of 129 toxic substances. In addition to the chemical data, fish toxicity bioassays were performed on the Central Plant effluent and the Sacramento River samples. Filtered and nonfiltered samples were collected on Central effluent and Sacramento River water. These samples were analyzed for heavy metals to determine the proportion of metals in soluble form versus attached to suspended solids.

A report on the toxicant monitoring program was completed in July 1979. The data collected will also provide a basis for reviewing and commenting on the EPA draft regulations for water quality criteria that were issued in the March 15, 1979 Federal Register.

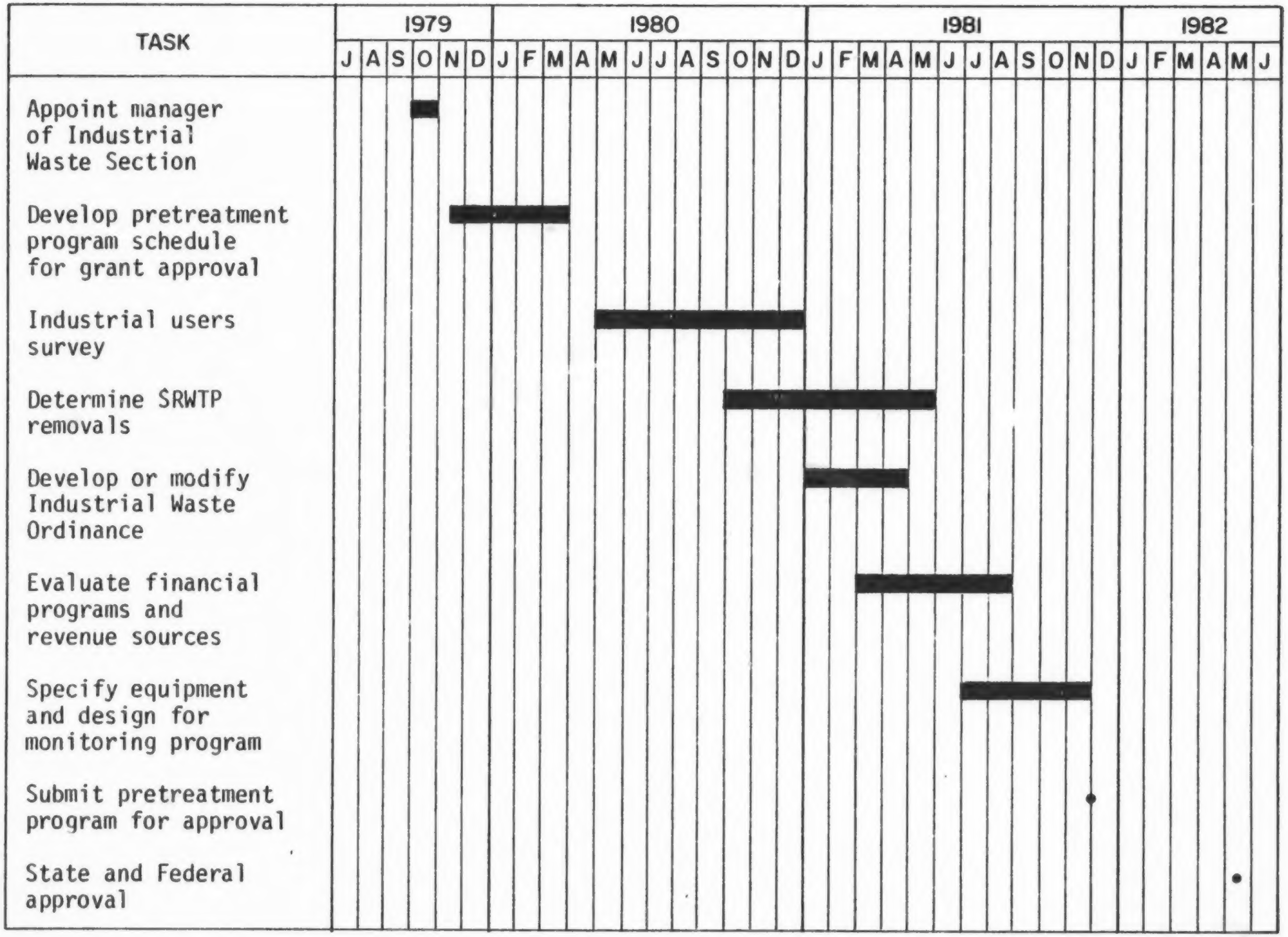

Fig. 1-1 Pretreatment Program Implementation Schedule

CHAPTER 2

PROCEDURES AND ANALYTICAL RESULTS

During the Phase I Source Survey samples of raw sludges, influents, and effluents were collected on a daily basis from 10 treatment plants. A portion of each daily sample was combined to make a weekly composite for analysis. The remainder of the daily samples were placed in freezer storage at 0° to 6°F. In the Phase I recommendations, it was concluded that daily samples of influent and effluent from City Main for the entire 35 days and raw sludge for weeks 3 and 4 from Central be analyzed. All of the samples were removed from a local cold storage facility and those scheduled for reanalysis were transported to the Environmental Sciences Division of Brown and Caldwell. The remainder of the samples were transported to the County landfill for disposal.

City Main Influent and Effluent Analysis

This section presents the rationale for reanalysis of the 35 daily influent and effluent samples from City Main and presents the results and conclusions obtained.

Reason for Reanalysis. In addition to the conclusion that levels of nickel and lead from unidentified sources in excess of a domestic level were being discharged to City Main, it was found that higher concentrations of nickel and lead were being discharged in the effluent than measured in the influent. To verify this result, all the daily influent and effluent samples from City Main were analyzed for nickel and lead.

Analytical Results. Results of analysis of daily influent and effluent samples from City Main are presented in Table 2-1. The results essentially substantiate the conclusions in the Phase I report, namely that occasional slugs of nickel and lead in excess of domestic contributions are present in the influent and that the total mass of nickel in the effluent exceeds the total mass of nickel in the influent. There was some discrepancy between the average of the analytical result of the daily samples for each week as compared to the analysis of the weekly composite as determined in Phase I but this does not significantly affect the conclusions.

Table 2-1. Analytical Results of Daily Samples of City Main Influent and Effluent

Week Number	Sample collection date, 1977	City Main							
		Lead				Nickel			
		Influent		Effluent		Influent		Effluent	
		mg/l	1,000 gms/day	mg/l	1,000 gms/day	mg/l	1,000 gms/day	mg/l	1,000 gms/day
1	4/17	0.020	3.26	0.033	5.37	0.048	7.81	0.21	34.2
	4/18	0.020	3.26	0.023	3.74	0.048	7.81	0.20	32.6
	4/19	0.040	6.51	0.038	6.18	0.048	7.81	0.21	34.2
	4/20	0.036	5.86	0.027	4.39	0.048	7.81	0.26	42.3
	4/21	0.036	5.86	0.024	3.91	0.11	17.9	0.24	39.1
	4/22	0.019	3.09	0.016	2.60	0.040	6.51	0.18	29.3
	4/23	0.008	1.30	0.014	2.28	0.048	7.81	0.20	32.6
2	4/24	0.010	1.63	0.014	2.28	0.060	9.77	0.20	32.6
	4/25	0.031	5.05	0.013	2.12	0.13	21.2	0.13	21.2
	4/26	0.013	2.12	0.021	3.42	0.10	16.3	0.12	19.5
	4/27	0.029	4.72	0.016	2.60	0.64	10.4	0.18	29.3
	4/28	0.038	6.18	0.017	2.77	0.064	10.4	0.16	26.0
	4/29	0.036	5.86	0.016	2.60	0.064	9.11	0.18	29.3
	4/30	0.040	6.51	0.019	3.09	0.052	8.46	0.20	32.6
3	5/1	0.084	13.7	0.037	6.02	0.044	7.16	0.15	24.4
	5/2	0.039	6.35	0.024	3.91	0.064	10.4	0.19	30.9
	5/3	0.048	7.81	0.016	2.60	0.076	12.4	0.16	26.0
	5/4	0.048	7.81	0.016	2.60	0.052	8.46	0.18	29.3
	5/5	0.056	9.11	0.019	3.09	0.068	11.1	0.17	27.7
	5/6	0.040	6.51	0.019	3.09	0.13	21.2	0.16	26.0
	5/7	0.044	7.16	0.011	1.79	0.80	130.2	0.27	43.9
4	5/8	0.020	3.26	0.018	2.93	0.068	11.1	0.22	35.8
	5/9	0.038	6.18	0.018	2.93	0.088	14.3	0.23	37.4
	5/10	0.056	9.11	0.034	5.53	0.080	13.0	0.20	32.6
	5/11	0.096	15.6	0.020	3.26	0.076	12.4	0.19	30.9
	5/12	0.030	4.88	0.021	3.42	0.052	8.46	0.18	29.3
	5/13	0.025	4.07	0.026	4.23	0.068	11.1	0.20	32.6
	5/14	0.036	5.86	0.022	3.58	0.052	8.46	0.17	27.7
5	5/15	0.017	2.77	0.013	2.12	0.040	6.51	0.15	24.4
	5/16	0.028	4.56	0.015	2.44	0.037	6.02	0.14	22.8
	5/17	0.033	5.37	0.025	4.07	0.052	8.46	0.14	22.8
	5/18	0.048	7.81	0.036	5.86	0.068	11.1	0.15	24.4
	5/19	0.052	8.46	0.027	4.39	0.056	9.11	0.15	24.4
	5/20	0.026	4.23	0.026	4.23	0.052	8.46	0.15	24.4
	5/21	0.040	6.51	0.026	4.23	0.060	9.77	0.17	27.7
Average			5.95		3.53		13.95		29.72

In Table 2-2, the average of the daily samples is compared to the composite results. In all cases, for both lead and nickel, the mechanical composite results are greater than the arithmetic average of analysis of the daily samples. The magnitude of the difference is greater for nickel than lead. A possible explanation of this difference may be from trace metal adsorption onto container walls during long term storage. Examination of the concentration ranges throughout the five weeks of discrete samples lends some support to this possibility. A uniform adsorption would not be expected. The influent samples have concentrations which are comparable to those reported in Phase I while the effluent daily samples are 25 to 50 percent less than the mechanical composite results. The reason for the discrepancy cannot be conclusively provided, though.

Conclusion. Based on the average for 35 days, nickel levels show a twofold increase through the City Main Plant as shown on Table 2-2 and Figure 2-1. As discussed in Phase I, the filtrate from the dewatering process which contains some of the ferric chloride used as a sludge conditioner for dewatering, is recycled to the primary sedimentation basins. Analysis of several ferric chloride solutions have indicated lead and nickel values ranging from 6 to 90 mg/l for lead and 92 to 6,200 mg/l for nickel. At these levels of contamination, the ferric chloride could possibly account for a twofold increase in nickel through the City Main plant. Also of note are the extremely high concentrations of nickel in the influent on May 7, 1977. This is probably indicative of a dump of some process waste into the sewer. The most likely source would be a plating shop. Other than that single day, the values do not vary greatly as can be seen on Figure 2-1.

The levels of lead found in the influent and effluent, although lower in the daily samples than the weekly composite for the effluent samples did not vary significantly from week to week. This can be seen by reviewing Figure 2-2, which is drawn on arithmetic paper. This data indicates that there were no major slug discharges of lead and that the treatment process removed 50 percent or less of the lead entering City Main plant. The average removal calculated from the daily samples is 50 percent, while the average removal from the weekly composite samples was zero.

Central Raw Sludge Analyses

This section reviews the rationale for selecting Weeks 3 and 4 of the Central raw sludge daily samples for reanalysis and presents the results and conclusions obtained.

Table 2-2. Comparison Average Daily vs. Composite Analytical Results

		City Main				Central
		Influent, mg/l		Effluent, mg/l		Raw sludge, mg/kg
Week	Sample	Lead	Nickel	Lead	Nickel	Cadmium[a]
1	Average[b]	0.026	0.056	0.025	0.21	
	Composite[c]	0.05	0.03	0.05	0.29	
2	Average[b]	0.028	0.075	0.017	0.017	
	Composite[c]	0.05	0.07	0.05	0.26	
3	Average[b]	0.051	0.18	0.02	0.18	71
	Composite[c]	0.02	0.15	0.04	0.23	72
4	Average[b]	0.043	0.069	0.023	0.20	46
	Composite[c]	0.06	0.12	0.05	0.26	43
5	Average[b]	0.035	0.052	0.24	0.15	
	Composite[c]	0.02	0.03	0.01	0.17	
Average of 35 daily samples		0.04	0.09	0.02	0.18	
Average of 5 composites/ samples		0.04	0.08	0.04	0.24	

[a] Weeks 1, 2, and 5 of Central raw sludge were not analyzed.
[b] Average of analyses of daily samples.
[c] Analysis of composite sample.

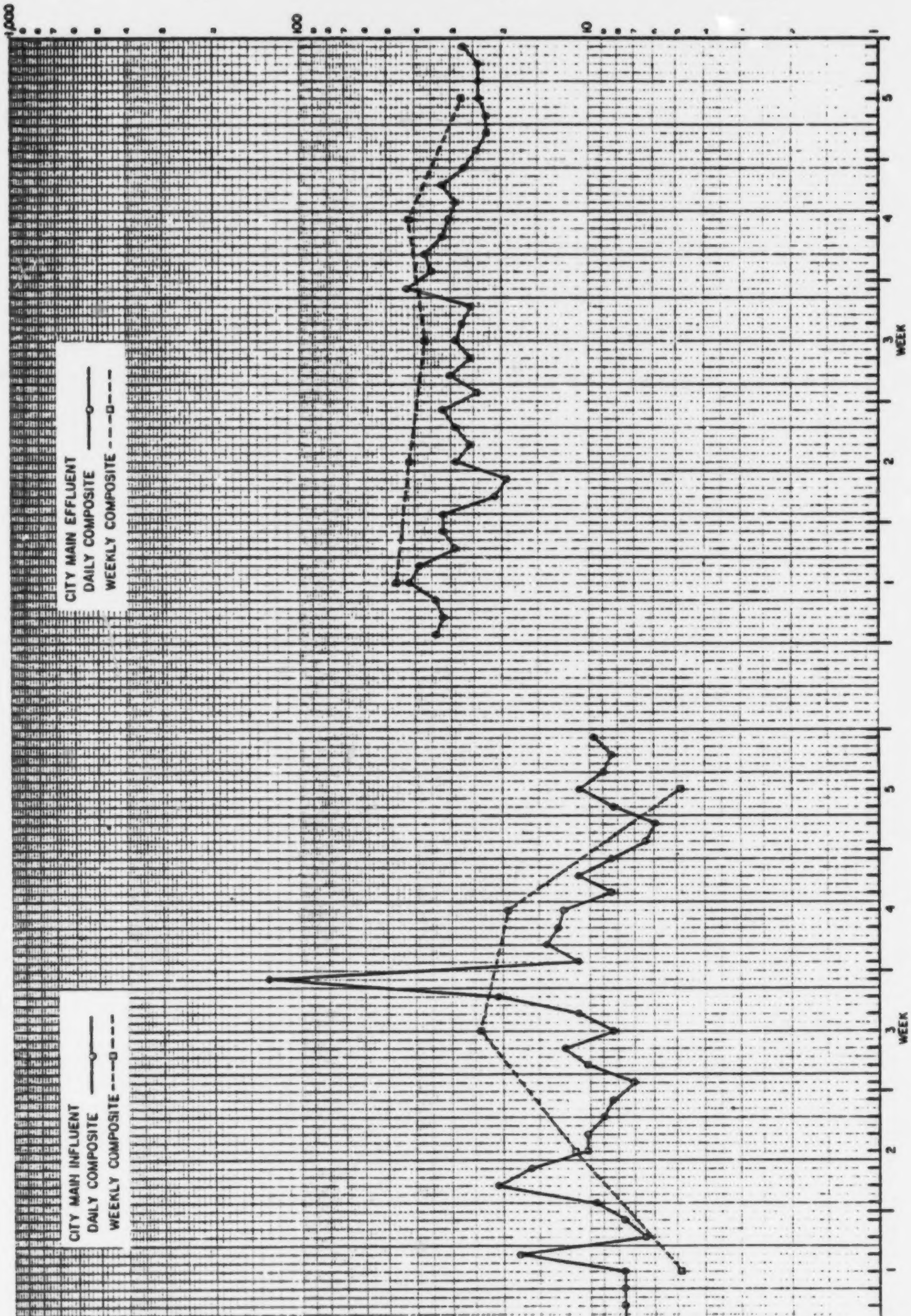

Fig 2-1 Nickel-City Main

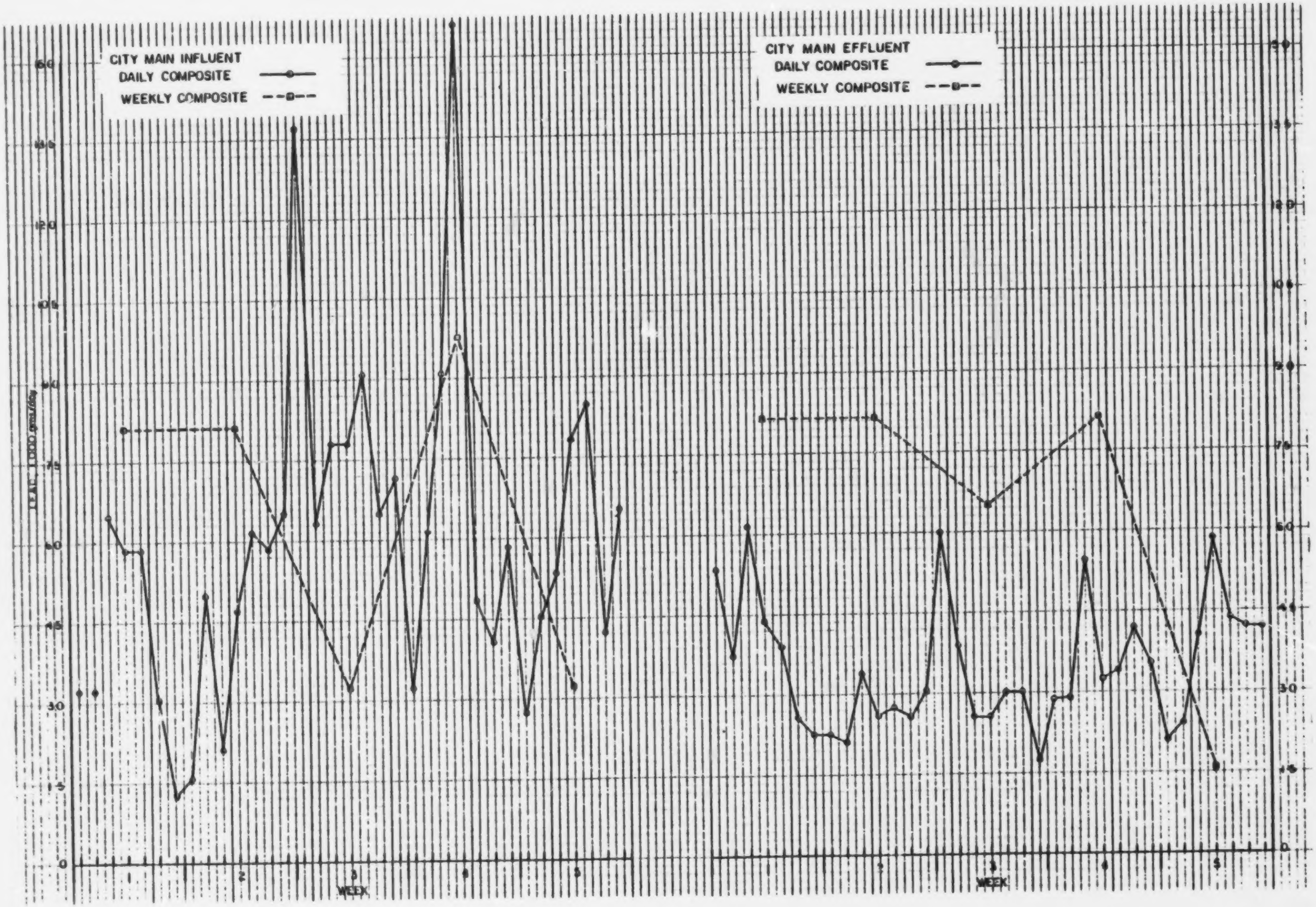

Fig. 2-2 Lead - City Main

Reason for Reanalysis. Analysis of composite raw sludge samples collected in Weeks 3 and 4 revealed significantly elevated levels of cadmium.

Analytical Results. The results showed a massive discharge of cadmium to Central treatment plant on the seventh day of the third week as shown in Figure 2-3 and Table 2-3. The cadmium concentrations on the six days preceding the slug ranged from 1.5 to 4.8 mg/kg and the slug was 480 mg/kg. It took about a week for the concentration of cadmium in the raw sludge to drop below 10 mg/kg. This was probably due to a residual amount of cadmium in the primary sludge. It is interesting to note that the weekly composite influent sample, as presented in the Phase I report, did not detect this slug of cadmium. The most probable explanation is the slug was concentrated enough that it went past the influent sample point between the times when an individual aliquot had been collected by the composite sampler. The potential for wide variability in influent concentrations of toxicants will complicate the detection and control of toxicant discharges to a treatment plant.

Table 2-3. Analytical Results of Daily Samples of Central Raw Sludge

Week Number	Sample Collection Date, 1977	Cadmium	
		mg/kg	gm/day
3	5/1	2.7	76
	5/2	4.8	135
	5/3	4.3	121
	5/4	3.4	96
	5/5	1.8	51
	5/6	1.5	42
	5/7	480	13,527
4	5/8	220	4,613
	5/9	39	818
	5/10	25	524
	5/11	15	315
	5/12	6.4	134
	5/13	10	210
	5/14	9.2	193

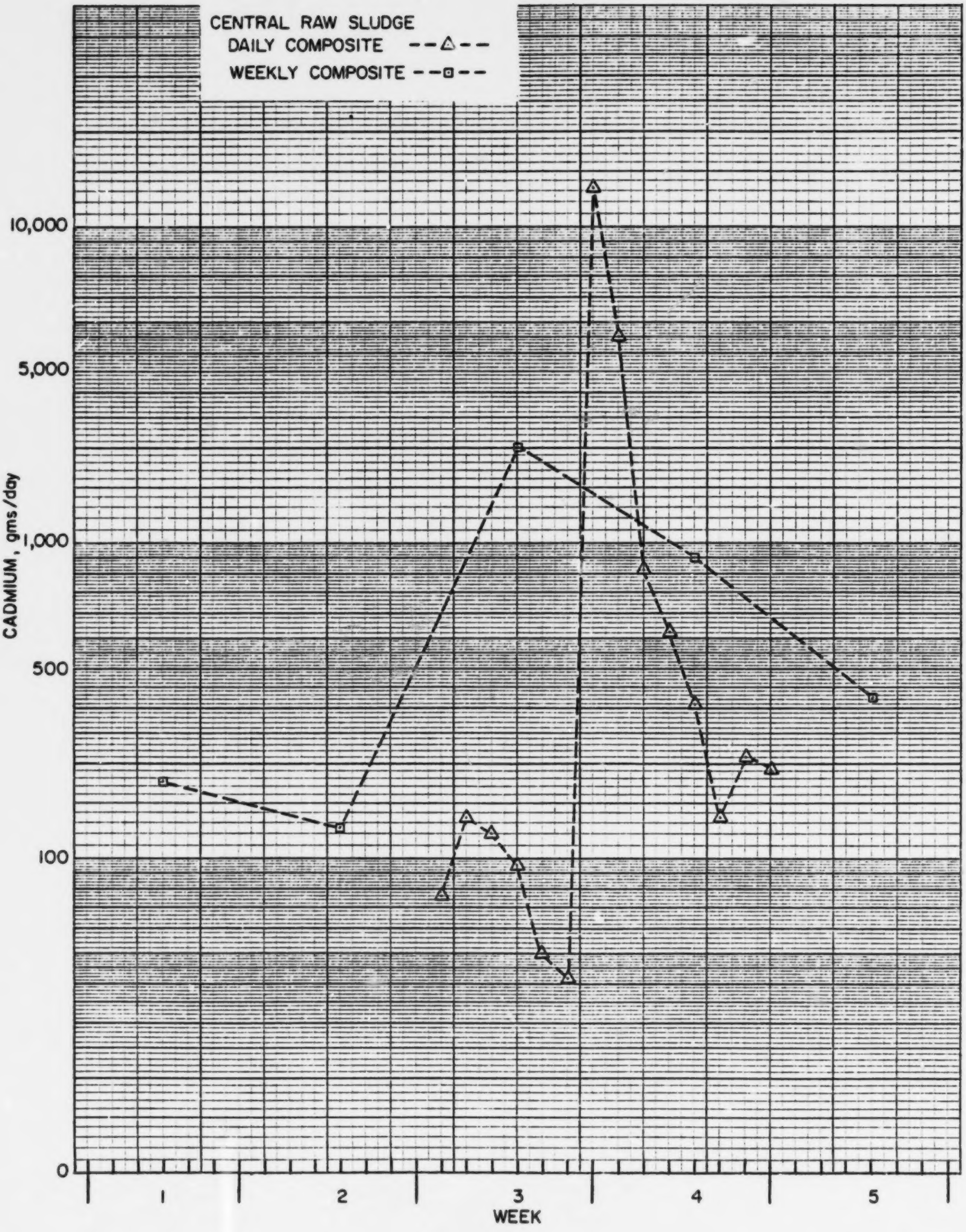

Fig 2-3 Cadmium - Central

Summary

The nickel and lead loads in the City Main influent varied within a fairly constant range except for a single day when a slug load of nickel was detected. Comparing the influent and effluent data for nickel showed a twofold increase in nickel through the treatment process. This increase in nickel can possibly be attributed to ferric chloride additions for sludge dewatering, since it contains varying amounts of nickel and lead. The lead data from the average of the 35 daily analyses showed a fifty percent removal for lead as compared to no removal when calculated based on the analyses of the five weekly composites. The cause of this discrepancy may be related to changes in storage or the compositing of the weekly samples.

At the Central treatment plant, the rather low level of cadmium found in the raw sludge was punctuated by a massive discharge on one day. The residual of this discharge took several days to clear out of the treatment process.

The data collected in Phase I and Phase II of the SSMP Source Survey and that being collected in the Toxic Pollutant Survey, will be invaluable in developing a pretreatment program and in responding to pending development of more stringent discharge requirements for toxic pollutants.

APPENDIX A

ENVIRONMENTAL PROTECTION AGENCY REGULATIONS FOR PRETREATMENT OF INDUSTRIAL WASTES

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ENVIRONMENTAL PROTECTION AGENCY REGULATIONS FOR PRETREATMENT OF INDUSTRIAL WASTES

The pretreatment regulations, as promulgated, are included in the Code of Federal Regulations, Title 40, Chapter I - Environmental Protection Agency, Subchapter N - Effluent Guidelines and Standards, Parts 400 to 460. Table A-1 presents a list of all of the 21 industrial categories which were identified in the 1976 Consent Decree (NRDC vs Train). Eight of these categories were of immediate concern so the consent decree directed that interim standards be promulgated. The dates of promulgation are shown in Table A-1. General pretreatment standards or general discharge prohibitions as defined in Part 403 apply to the remaining 13 industries listed in Table A-1 until categorical standards are promulgated in late 1979 and 1980. The categorical standards will add to the general pretreatment standards, not supersede them. The EPA has published several lists of tentative proposal dates for the final categorical pretreatment standards. In almost all cases these dates have been substantially exceeded. The latest list is included as Table A-2. The dates are meaningless but the table does show the approximate order in which the regulations will be promulgated. For the Miscellaneous Chemicals and Machinery and Mechanical Products categories there are numerous subcategories with different proposal dates.

The following sections present a list of references from the Federal Register. These reference pretreatment standards or relevant decisions for the eight industrial categories for which interim standards were promulgated. Pretreatment standards for the remaining industries will be promulgated in late 1979 and early 1980.

General Pretreament Regulations

40 CFR 128 (EPA), Pretreatment Standards, Federal Register, dated November 11, 1973, superseded by 40 CFR 403.

40 CFR 403 (EPA), General Pretreatment Regulations of Existing and New Sources of Pollution, Federal Register, dated June 26, 1978.

Electroplating

40 CFR 413 (EPA), Electroplating Point Source Category, Federal Register, April 24, 1975.

Table A-1. 21 Industrial Categories Identified in Consent Decree

Interim Standards Promulgated	Part[a]	Industrial Category
	[b]	Auto and Other Laundries
	434	Coal Mining
2/14/78	413	Electroplating
7/20/77	415	Inorganic Chemicals Manufacturing
	420	Iron and Steel Manufacturing
3/23/77	425	Leather Tanning and Finishing
	[b]	Machinery and Mechanical Products Manufacturing
	[b]	Miscellaneous Chemicals Manufacturing
9/15/76	421	Nonferrous Metals Manufacturing
	440	Ore Mining
	414	Organic Chemicals Manufacturing
	446&447	Paint and Ink Formulation and Printing
	443	Paving and Roofing Materials
3/23/77	419	Petroleum Refining
	416	Plastic and Synthetic Materials Manufacturing
	430	Pulp and Paperboard Mills and Converted Paper Products
	428	Rubber Processing
	417	Soap and Detergent Manufacturing
3/23/77	423	Steam Electric Power Plants
5/26/77	410	Textile Mills
12/ 9/76	429	Timber Products Processing

[a] Refers to Part of Subchapter N, Title 40, Code of Federal Regulations

[b] Part not determined yet.

Table A-2. Proposal Dates-Categorical Pretreatment Standards

Category	Date
Timber Products Processing	9/30/78
Steam Electric	8/31/79
Leather Tanning and Finishing	12/30/78
Iron and Steel Manufacturing	6/30/79
Petroleum Refining	4/ 9/79
Nonferrous Metals	5/ 7/79
Paving and Roofing	--
Paint and Ink Formulation	5/31/79
Printing and Publishing	5/ 1/80
Ore Mining	12/31/78
Coal Mining	8/31/79
Organic Chemicals	9/30/79
Inorganic Chemicals	5/31/79
Textile Mills	3/31/79
Plastics and Synthetic Materials	9/30/79
Pulp and Paper	6/30/79
Rubber	6/30/79
Soaps and Detergents	9/30/79
Auto and Other Laundries	6/30/79
Miscellaneous Chemicals	
Pesticide Manufacturing	10/31/79
Gum and Wood Chemicals	6/30/79
Pharmaceutical Manufacturing	6/30/79
Explosives Manufacturing	7/31/79
Adhesives and Sealants	6/30/79
Carbon Black	6/30/79
Machinery and Mechanical Products	
Mechanical Products	5/ 1/80
Battery Manufacturing	11/15/79
Plastics Processing	11/30/8[illegible]
Foundries	7/27/79
Coil Coating	6/29/79
Porcelain Enameling	6/22/79
Aluminum Forming	12/31/79
Copper & Copper Alloy Products	11/16/79
Electrical & Electronic Components	5/ 1/80
Shipbuilding	6/30/79
Photographic Equipment & Supplies	12/30/79
Electroplating	12/15/79

40 CFR 413 (EPA), Electroplating Point Source Category; Interim Final Regulations, Federal Register, dated July 12, 1977.

40 CFR 413 (EPA), Electroplating Point Source Category - Proposed Pretreatment for Existing Sources, Federal Register, dated February 14, 1978.

40 CFR 413 (EPA), Electroplating Point Source Category - Suspension of Interim Final Regulation, Federal Register, dated May 14, 1979.

Inorganic Chemicals Manufacturing

40 CFR 415 (EPA), Inorganic Chemicals Manufacturing Point Source Category, Federal Register, dated March 12, 1974.

40 CFR 415 (EPA), Inorganic Chemicals Manufacturing Point Source Category, Pretreatment Standards for Existing Sources; Interim Final Regulations, Federal Register, dated July 20, 1977.

Leather Tanning and Finishing

40 CFR 425 (EPA), Leather Tanning and Finishing Industry Point Source Category, Federal Register, dated April 9, 1974.

40 CFR 425 (EPA), Leather Tanning and Finishing Point Source Category, Pretreatment Standards for Existing Sources, Federal Register, dated March 23, 1977.

40 CFR 425 (EPA), Leather Tanning and Finishing Point Source Category Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards, Proposed Regulation, Federal Register, dated July 2, 1979.

Nonferrous Metals Manufacturing

40 CFR 421 (EPA), Nonferrous Metals Manufacturing Point Source Category, Federal Register, dated April 8, 1974.

40 CFR 421 (EPA), Nonferrous Metals Manufacturing Point Source Category, Pretreatment Standards for Existing Sources, Interim Rulemaking, Secondary Aluminum Smelting and Secondary Copper Subcategories, Federal Register, dated December 15, 1976.

Petroleum Refining

40 CFR 419 (EPA), Petroleum Refining Point Source Category, Federal Register, dated May 9, 1974.

40 CFR 419 (EPA), Petroleum Refining Point Source Category, Pretreatment Standards for Existing Sources, Final Regulations, Federal Register, dated March 23, 1977.

Steam Electric Power Plants

40 CFR 423 (EPA), Steam Electric Power Generating Point Source Category, Federal Register, dated October 8, 1974.

40 CFR 423 (EPA), Steam Electric Power Generating Point Source Category Pretreatment Standards for Existing Sources, Interim Regulations, Federal Register, dated March 23, 1977.

Textile Mills

40 CFR 410 (EPA), Textile Industry Point Source Category, Federal Register, dated July 5, 1974.

40 CFR 410 (EPA), Textile Industry Point Source Category, Pretreatment Standards for Existing Sources, Final Rulemaking, Federal Register, dated May 26, 1977.

Timber Products Processing

40 CFR 429 (EPA), Timber Products Processing Point Source Category, Federal Register, dated April 18, 1974.

40 CFR 429 (EPA), Timber Products Processing Point Source Category, Pretreatment Standards for Existing Sources; Interim Final Rulemaking, Federal Register, dated December 9, 1976.